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COMPARATIVE BIOMETRICAL STUDY OF PHYSIQUE OF JAPANESE WOMEN BORN AND REARED UNDER DIFFERENT ENVIRONMENTS

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INTRODUCTION — PURPOSE OF STUDY

IT has been shown by Boas (1), and others that the decendants of European immigrants coming to the eastern United States change in physical type from that of their parents. Spier (2), in his study, has suggested that American-born Japanese children are physically different from children of the parental type in Japan. These studies deal chiefly with stature, weight, and cephalic index. Gould (3), in his study of stature, weight, and body build on female college students of the Gulf Coast states, concluded that there were mean differences in physique, due to diverse national origins, which persist even after several generations of American life and the intermarriage of various stocks. His study showed also that there was a characteristic slenderness of build in these subjects that cannot be wholly accounted for on the basis of ancestry.

There is a considerable amount of literature concerning the growth aspect of the American-born Japanese. Most of these studies are on school children (4), two are on adults (5), and one each for infants (6-a) and newborn (6-b). They all agree that the Japanese who were born and reared in America are decidedly larger than those of the

corresponding groups in Japan proper. In my last study I showed that the newborn babies of Japanese parentage in the United States appeared to be far superior in their physical growth at birth to those born in Japan proper, but the characteristic body proportions or anthropometrical aspects of the Japanese infant were found fully retained under the new environment (6-b). In the present study the course of growth of Japanese women who were born and reared under the different environment of Japan and of America is traced and an attempt is made to show the differences, if any, in body type and build, physiological development and function between each.

As to the cause of the differences in the physique of descendants of immigrants on this continent there exist two different opinions: (a) the effect of the environment, (b) the "process of selection". The selection theory is based on the fact that, for instance, the majority of the Japanese in America have come from the larger stature regions in Japan, that the process of stature increase in the civilized world today is phenomenal, and that it is even more striking in Japan. To answer this question is one of the objects of the present study.

In order to approach the solution of the above problems, the anthropometrical measurements, blood pressure readings, and determinations of menarcheal ages were made on several different groups of Japanese women who were born and reared under the different environments of Japan and of America. These have been statistically treated and compared. I have also undertaken to compare the results obtained with those of various groups of women of other important races, such as white, Negro, American Indian on the Pacific Coast, and so forth, when comparable data were available, as this is a study which deals chiefly with the influence and effect of environment on the growth of man.

MATERIAL, METHODS AND TREATMENT OF DATA

Material

A. Group of Japanese women who were born and reared in the United States of America—Nisei—135 in number. The average age is a little over 23 years, ranging from 18 to 30 years. Sixty-one, or 45.2 per cent of the group, are single. Of these 14 are students; 25, office workers; 2, school teachers; and the rest salesgirls, maids, etc. Seventy-four, or 54.8 per cent, are married and mothers of one or

more children (except 3), and most of them are employed in offices and shops. One hundred and nine, or 80.7 per cent of the group, are graduated from high schools; 8, or 5.9 per cent, from junior high schools; and 15, or 11.1 per cent, from colleges. Only 3, or 2.2 per cent, are from grammar schools. Their birthplaces are given in Table 1. One hundred and two, or 75.6 per cent, were born in California (So. Cal. alone, 54.8 per cent); thirteen, or 9.6 per cent,

TABLE 1

Birthplaces of the United States born Japanese women by groups

BIRTHPLACE	GROUP U.S.A.		GROUP U.S.-JAPAN	
	Number	*Percent*	*Number*	*Percent*
California	102	75.6	103	82.4
Southern California	74	54.8	71	56.8
Northern California	28	20.8	32	25.6
Oregon	3	2.2	3	2.4
Washington	13	9.6	10	8.0
Utah	5	3.7	3	2.4
Colorado	3	2.2	2	1.6
Idaho	2	1.5	0	0.
Wyoming	1	0.7	0	0
Hawaii	6	4.4	4	3.2
Total	135	99.9	125	100.0

in the State of Washington; the rest in different states on the Pacific coast and intermountain regions. Hereafter this group will be called *Group U.S.A.* To know the original places their parents have come from is very important, as there is a geographical difference in stature distribution in Japan. According to the statistical report by the Department of War of the Japanese Government (7) in 1936 (survey from 1928-1932), the highest stature regions were Kinki, Chiugoku, and Northern Kyushu. The shortest reported were Okinawa, Kanto, and Southeastern Kyushu. Tohoku, Chiubu, Shikoku regions were intermediate. The above report was generally agreed upon by Hasebe (8) in his study (1917) on the recruits and Matsumura (9) on students (1923).

TABLE 2

Birthplaces by section of the parents of the Japanese women by groups

BIRTHPLACE	U.S.A.				U.S.-JAPAN				JAPAN	
	Mother		Father		Mother		Father		Place of origin	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
Hokkaido*	1	0.7	..	...	..	...	..	...	3	2.0
Tohoku**	14	10.4	15	11.1	4	3.2	5	4.0	23	15.3
Kanto†	6	4.4	5	3.7	6	4.8	5	4.0	76	50.7
Chiubu**	15	11.1	13	9.6	11	8.8	13	10.4	29	19.3
Kinki*	13	9.6	16	11.9	16	12.8	14	11.2	2	1.3
Chiugoku*	56	41.5	55	40.7	60	48.0	60	48.0	3	2.0
Shikoku**	3	2.2	3	2.2	1	0.8	1	0.8	..	...
Kyushu (N.)*	18	13.3	19	14.1	20	16.0	20	16.0	..	...
Kyushu (S.E.)†	9	6.7	7	6.7	7	5.6	7	5.6	4	2.7
Unknown	..	...	..	...	..	...	..	...	10	6.7
Total	135	99.9	135	100.0	125	100.0	125	100.0	150	100.0

* Higher stature region; ** Intermediate stature region; † Lower stature region.

It appears from Table 2 that the birthplaces of both mothers and fathers are almost alike and chiefly from the higher stature regions, namely, Chiugoku Section, 40.7 per cent for the fathers, 41.5 per cent for the mothers; Kyushu Section, 20.7 per cent for fathers and 20 per cent for mothers; Kinki and Chiubu Sections, 21.5 per cent for fathers and 20.7 per cent for mothers; the rest are unimportant.

B. Group of Japanese women who were born in the United States but reared in Japan from infancy and childhood until they returned again to the United States to live up to the present time—Kibei-Nisei—125 in number. The average age is 23 years 11 months, ranging from 18 to 30 years. The average age when they went to Japan was 3 years 8 months, ranging from 6 months to 9 years (Table 3). The average age when they returned to the U.S.A. was 17 years 10 months. This makes the average duration of residence in Japan 14 years 2 months (59.2 per cent of life) and in the U.S.A. 9 years 5 months (40.7 per cent of life). It is important to note that this group of women, while in Japan, was living in the regular Japanese manner. From Table 1, 103, or 82.4 per cent of the total number, were born in California (71 or 56.8 per cent in So. California), the rest being born in Oregon

TABLE 3

Life histories of women in group U. S.-Japan

Showing the frequency distributions of the ages when they went to Japan, with the average age upon return to the U.S.A., and the average duration in Japan and the U.S.A.

AGE INTERVAL WENT TO JAPAN (*Year*)	FREQUENCY		AVERAGE AGE RETURN TO U.S.A. (*Year*)	AVERAGE DURATION IN JAPAN (*Year*)	AVERAGE DURATION AFTER RETURNING TO U.S.A. (*Year*)	PRESENT AVERAGE AGE (*Year*)
	No.	Percentage				
0-1	11	8.8	17	17	6	23
1-2	9	7.2	19	18	6	24
2-3	14	11.2	19	17	7	24
3-4	12	9.6	19	17	7	24
4-5	17	13.6	18	14	9	23
5-6	20	16.0	17	12	11	23
6-7	20	16.0	19	13	11	24
7-8	9	7.2	19	12	12	24
8-9	13	10.4	19	11	12	23
Total	125	100.0				

From original data:
Average age of the Group = 23 yrs. 11 mos.
Average age went to Japan = 3 yrs. 8 mos.
Average age return to U.S.A. = 17 yrs. 10 mos.
Average duration in Japan = 14 yrs. 2 mos.
Average duration in U.S.A. = 9 yrs. 5 mos.

and Washington and intermountain states, but are now living in the city of Los Angeles or vicinity. One hundred and fifteen, or 92 per cent of them, are married and mothers of one or more children, except 2 who have none. Most of their husbands are laborers, the remainder being a few small storekeepers. Twenty-seven, or 21.6 per cent, went through grammar school; 98, or 78.4 per cent received high school education in Japan; but there is no college graduate. This group will be called hereafter, *Group U.S.-Japan.* The birthplaces of the parents of this group are very similar to those of the Group U.S.A.; that is, for the fathers, 48 per cent originated in Chiugoku section; 21.6 per cent in Kyushu; 11.2 per cent in Kinki; and 10.4 per cent in Chiubu; the rest are unimportant. For the mothers, 48 per cent originated in Chiugoku; 21.6 per cent in Kyushu; 8.8 per cent in Chiubu; 3.2 per cent in Tohoku; and 12.8 per cent in Kinki; the rest are unimportant

(Table 2). The birthplaces of the parents of both groups, Group U.S.A. and Group U.S.-Japan, are then almost identically the same.

C. Group of Japanese women who were born and reared in Japan proper was 150 in number. The average age is 21 years 10 months, ranging from 18 years to 30 years. The educational status of this group is slightly lower than the other two. One hundred and eighteen, or 81.94 per cent of the group, are nurses in hospitals, the rest are employed in schools, offices, shops, etc.; only 18, or 12 per cent, are married. Hereafter this group will be called *Group Japan*. The majority of the known places of origin of the women in this group are: in the Kanto section, 76, or 50.7 per cent; Chiubu, 29, or 19.3 per cent; Tohoku, 23, or 15.3 per cent; the unknown 10, or 6.7 per cent, and the rest are unimportant (Table 2). Kanto Section, the dominant birthplace of the women in this group, is one of the regions of lower stature in Japan proper but the great majority of this group consisted of nurses, who are regarded as the physically best balanced women, as Dr. Takeuchi's (10) findings throughout her series of studies have shown. This point is important in this comparative study.

D. Group of Japanese women who were born in Japan but reared in the United States from infancy and childhood was 7 in number. The places of their origin are generally the same as those of Group U.S.A. and the U.S.-Japan, namely Chiugoku predominating, then Chiubu and Kyushu sections. The average age when they came to

TABLE 4

Life histories of women in Group Japan-U.S.
Showing present age, age when they came to America and duration in America.

INDIVIDUAL	AGE AT PRESENT		AGE CAME TO U.S.A.		DURATION IN U.S.A.	
	Yrs.	*Mos.*	*Yrs.*	*Mos.*	*Yrs.*	*Mos.*
Mrs. H.....	36	0	1	0	35	0
Miss Y.....	23	1	8	0	15	1
Mrs. S.....	32	3	1	0	31	3
Mrs. T.....	26	2	7	8	18	6
Miss Y.....	23	0	4	7	18	5
Miss H.....	20	1	2	3	17	10
Mrs. I.....	25	0	4	1	20	11
Total	185	7	27	7	157	0
Average	26	6	4	1	22	5

America was 4 years 1 month, ranging from one year to eight years, almost the same average age as those of Group U.S.A. when they came to America (Table 4). The present average age is 26 years 6 months, ranging from 20 to 36 years, which makes the average duration in America 22 years 5 months; 4 married and 3 single; 1 college graduate and 6 high school graduates. This class of women, hereafter, will be called *Group Japan-U.S.* for the convenience of the study, and will be quoted for comparison as the study goes on since the results obtained are very suggestive.

E. With the exception of a few, the women students at the City College of Los Angeles, numbered 2545. They were composed of the following different races, namely:

White	2138
Japanese	173
Negress	165
Mexican	52
Chinese	17
Total	2545

This material was used for the determination of the average at menarche for each different race in Southern California, parallel with the present study of Japanese women. The material was available through the interest and courtesy of the college physician, Dr. Freda Haffner.

Methods and treatment of data

A. Anthropometric measurements

The principle and technique used for measuring each subject followed as much as possible the method which was given in the international agreement for the unification of anthropometric measurements (to be made on living subjects) adopted by the commission at a meeting on Sept. 14, 1912, at Geneva (11). In those which are not given in the agreement, I followed the methods given by Wilder (12) or Hrdlička (13) or when necessary that given in Martin's (14) *Lehrbuch der Anthropologie.* All the measurements were made by myself with an experienced assistant, in the specially equipped laboratory room of my medical office suite, between two to five P.M. during the years of 1937 and 1938. The women in Group Japan were measured by Dr.

Suzuki at the Sanraku Hospital, Tokyo, Japan, with the same method and technique that were employed by myself.

B. Blood pressure

The indirect and auscultatory method of Korotkow (15, 16) with a standard mercury manometer and a cuff 13½ cm. in width was used. After resting at least 5 minutes or more, the subject was instructed to have the proper mental attitude to register correct blood pressure. With the subject sitting, the right arm was used. The apparatus was at about the level of the heart.

1. Systolic pressure—The beginning of the first sound (Phase I of sounds of Korotkow) was taken, when the pressure of the bug of the cuff was released, as the index of systolic pressure.

2. Diastolic pressure—The fourth sound (Phase IV of sounds of Korotkow) just before its complete disappearance was taken as the index of the diastolic pressure.

3. Pulse pressure—This is not a real pressure but the difference between the systolic and diastolic pressures.

C. Menarcheal age

This study is based on the subjects' history notes or memory or sometimes by the assistance of their mothers' memory or both, if necessary, to obtain the accurate age. To calculate the means from the data, the menarcheal ages given by the subjects' answers to the questionnaire carefully prepared by the investigator are grouped to their nearest birthdates; for instance, the age class 14 includes all girls younger than 14½ and older than 13½ as being in the fourteenth year of life, and the arithmetic mean is deducted. This method was advocated by Weissenberg (17) and I believe it is the most practical one for this study, as most girls were found to start menstruating around or near their birthdate.

For treatment of data, those of the usual "Pearsonian" biometrical and statistical methods were employed, using in general the formulas as given by Pearl (18).

RESULTS AND COMPARATIVE STUDY

I. Age (Table 5)

The range of age in each group is 18 to 30 years. Mean of Group U.S.A. is 23.04 ± 0.20 years, or 23 yrs. 0.5 mos., with a standard deviation of 3.54 ± 0.14 years, or 3 yrs. 5.5 mos. (V =

14.95 ± 0.61). In Group U.S.-Japan it is 23.91 ± 0.17 years, or 23 yrs. 11 mos., with the standard deviation, 2.75 ± 0.08 years, or 2 yrs. 9 mos. ($V = 11.64 \pm 0.50$) and that of Group Japan is 21.83 ± 0.17, or 21 yrs. 10 mos., with the standard deviation, 2.75 ± 0.08 years, or 2 yrs. 9 mos. ($V = 12.65 \pm 0.49$). It appears that there is approximately a difference of one year between the average age in

TABLE 5

Age: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
	RANGE (*mm.*)	18-30			18-30			18-30		
FREQUENCY DISTRIBUTION	Classes grouped in one year	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	18-18.9	9	6.7	6.7	2	1.6	1.6	18	12.0	12.0
	19-19.9	14	10.4	17.0	6	4.8	6.4	17	11.3	23.3
	20-20.9	13	9.6	26.7	5	4.0	10.4	24	16.0	39.3
	21-21.9	17	12.6	39.3	16	12.8	23.2	22	14.7	54.0
	22-22.9	11	8.2	47.4	20	16.0	39.2	21	14.0	68.0
	23-23.9	14	10.4	57.8	19	15.2	54.4	14	9.3	77.3
	24-24.9	14	10.4	68.2	19	15.2	69.6	8	5.3	82.7
	25-25.9	10	7.4	75.6	7	5.6	75.2	10	6.7	89.3
	26-26.9	11	8.2	83.7	10	8.0	83.2	7	4.7	94.0
	27-27.9	8	5.9	89.6	14	11.2	94.4	3	2.0	96.0
	28-28.9	5	3.7	93.3	1	.8	95.2	1	.7	96.7
	29-29.9	3	2.2	96.6	3	2.4	97.6	4	2.7	99.3
	30-30.9	6	4.4	100.0	3	2.4	100.0	1	.7	100.0
	Total	135	100.1		125	100.0		150	100.1	
STATISTICAL CONSTANTS	$M \pm P.E.$ (Year)	23.04 ± 0.20			23.91 ± 0.166			21.83 ± 0.166		
	$\sigma \pm P.E.$ (Year)	3.45 ± 0.14			2.75 ± 0.083			2.75 ± 0.083		
	$V \pm P.E.$ (%)	14.95 ± 0.61			11.64 ± 0.500			12.65 ± 0.490		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
	$M \pm P.E.$ (Year)	+0.87 ± 0.258			−2.08 ± 0.233			+1.21 ± 0.258		
	$\sigma \pm P.E.$ (Year)	−0.708± 0.164			−0.00 ± 0.118			+0.708± 0.164		
	$V \pm P.E.$ (%)	−3.31 ± 0.79			+1.01 ± 0.70			+2.30 ± 0.78		

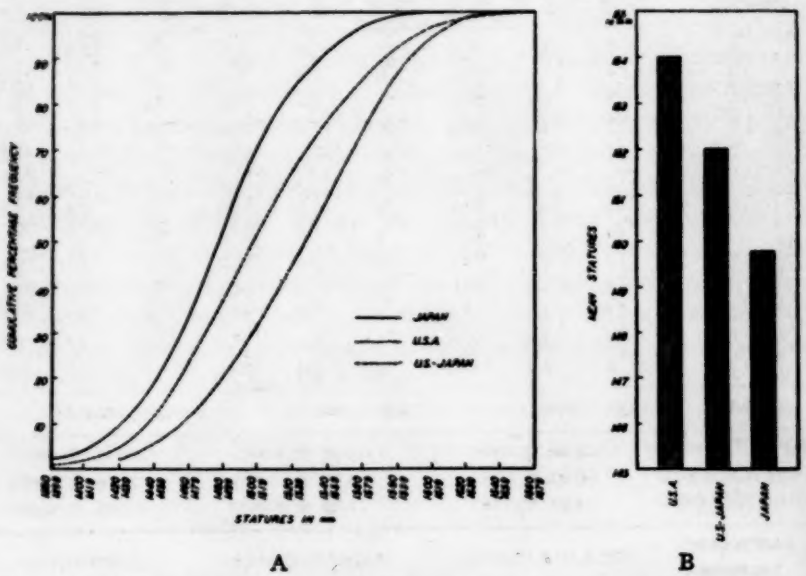
each group; Group U.S.-Japan, the oldest; Group Japan, the youngest; and Group U.S.A., the medium. The age difference among the groups, therefore, is unimportant in this study. The average age of Group Japan-U.S. is 26.5 years, the range from 20 to 26 years, with the exception of one, 36 years.

II. Anthropometric measurement

Stature (Table 6: Fig. 1)

Mean of Group U.S.A. exceeds that of Group U.S.-Japan by mm., $\sigma = 50 \pm 0.05$ mm. ($V = 3.25 \pm 0.14$). In Group U.S.-Japan it is 1519.3 ± 2.2 mm.; range = 1385-1674 mm., $\sigma = 54.9 \pm 1.16$ mm. ($V = 3.62 \pm 0.15$), and that for Group Japan, 1497.8 ± 2.5 mm.; range = 1390-1609 mm., $\sigma = 45.2 \pm 1.77$ mm., ($V = 3.02 \pm 0.12$).

Mean of Group U.S.A. is 1540.0 ± 2.4 mm.; range = 1420-1659 20.7 ± 3.26 mm. and that of Group Japan by 42.2 ± 3.48 mm., the



A B

FIG. 1(A). CUMULATIVE PERCENTAGE FREQUENCY OF STATURES OF THREE GROUPS OF JAPANESE WOMEN IN DIFFERENT ENVIRONMENTS
(B) MEAN STATURES OF THREE GROUPS OF JAPANESE WOMEN IN DIFFERENT ENVIRONMENTS

difference between the last two groups being 21.5 ± 5.52 mm. There is a difference of approximately 21 mm. between each group. Variability of Group U.S.-Japan, which is the greatest among all the groups, exceeds that of Group Japan by 0.60 ± 0.19 and that of Group U.S.A. by 0.37 ± 0.21: this is smaller than twice its probable error and is

TABLE 6

Stature: Showing range frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		1420-1659			1385-1674			1390-1609		
FREQUENCY DISTRIBUTION	Classes grouped in 20mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	1380-1399	..	...	...	1	.8	.8	3	2.0	2.0
	1400-1419	..	...	...	3	2.4	3.2	4	2.7	4.7
	1420-1439	3	2.2	2.2	2	1.6	4.8	10	6.7	11.4
	1440-1459	4	3.0	5.2	9	7.2	12.0	10	6.7	18.1
	1460-1479	9	6.7	11.9	17	13.6	25.6	27	18.0	36.1
	1480-1499	13	9.6	21.5	15	12.0	37.6	26	17.3	53.4
	1500-1519	20	14.8	36.3	18	14.4	52.0	27	18.0	71.4
	1520-1539	10	7.4	43.7	15	12.0	64.0	15	10.0	81.4
	1540-1559	26	19.3	63.0	16	12.8	76.8	13	8.7	90.1
	1560-1579	14	10.4	73.4	9	7.2	84.0	11	7.3	97.4
	1580-1599	18	13.3	86.7	9	7.2	91.2	2	1.3	98.7
	1600-1619	9	6.7	93.4	7	5.6	96.8	2	1.3	100.0
	1620-1639	8	5.9	99.3	2	1.6	98.4	..	...	...
	1640-1659	1	.7	100.0	1	.8	99.2	..	...	...
	1660-1679	..	...	...	1	.8	100.0	..	...	...
	Total	135	100.0		125	100.0		150	100.0	

STATISTICAL CONSTANTS			
$M \pm P.E.$ (*mm.*)	1540.00 ± 2.40	1519.30 ± 2.20	1497.80 ± 2.50
$\sigma \pm P.E.$ (*mm.*)	50.00 ± 2.05	54.90 ± 1.16	45.20 ± 1.77
$V \pm P.E.$ (%)	3.25 ± 0.14	3.62 ± 0.15	3.02 ± 0.12
DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN	U.S.-JAPAN-JAPAN	JAPAN-U.S.A.
$M \pm P.E.$ (*mm.*)	− 20.7 ± 3.26	− 21.5 ± 3.32	+ 42.2 ± 3.48
$\sigma \pm P.E.$ (*mm.*)	+ 4.9 ± 2.36	− 9.7 ± 2.12	+ 4.8 ± 2.71
$V \pm P.E.$ (%)	+ 0.37 ± 0.21	− 0.60 ± 0.19	+ 0.23 ± 0.18

probably not statistically significant. The difference between the last mentioned groups is also so slight that it is not of any statistical significance. The average stature of the limited number group, Group Japan-U.S., is 1539.7 mm.—practically equal to Group U.S.A.

By using the formula, $M + \sigma \rightarrow M - \sigma$, by Bautmann and J. Bauer (19), norm of stature for each group will be as follows:

Group	*Norm*	*Percentage of entire number*
U.S.A.	159 → 149 cm.	71.5
U.S.-Japan	157 → 146 cm.	72.0
Japan	154 → 145 cm.	72.5

Group U.S.A. exceeds 3 cm. in $M \rightarrow \sigma$ and 2 cm. in $M + \sigma$ over that of Group U.S.-Japan and 4 cm. in $M - \sigma$, 5 cm. in $M + \sigma$ over that of Group Japan.

Comparable data for various groups of Japanese women in Japan proper are shown in Table 7. The representative stature for matured (19-30 years) Japanese women in 16 different occupations in Japan proper by Takeuchi (10) was 149.2 ± 0.08 cm. with a standard deviation of 5.05 cm. ($V = 3.38$), range, 133-166 cm. It is about 6 mm. less than that of Group Japan in this study, 48 mm. than that of Group U.S.A., and 27.3 mm. than that of Group U.S.-Japan. Her tallest group "Mental worker", was 151.1 cm. but still it is about 30 mm. shorter than that of Group U.S.A. and about 10 mm. shorter than that of Group U.S.-Japan. Range of norm by Takeuchi was 154 cm. ($M + \sigma$) to 144 cm. ($M - \sigma$) which is 5 cm. smaller than that of Group U.S.A. and 3 cm. in M $+ \sigma$ and 2 cm. in M $- \sigma$ than that of Group U.S.-Japan. Average height of students in Japan proper was found by the Department of Education (20) to be 150.1 cm.—one of the highest stature classes in Japan. Tahara's (21) average stature of Northern Kyushu and Chiugoku, which are among the highest stature regions in Japan, was 150.3 cm. From this comparison it may be concluded that the average stature of Group U.S.A. is at least 40 mm. higher than that of the corresponding age group of the contemporary Japanese women in Japan proper and that of Group U.S.-Japan is in between the above two, or 20 mm.

It is apparent that this difference in stature among the various groups of Japanese women in the present study is due to the effect of the different environment where they were born and where they

TABLE 7

Average stature of matured Japanese women in Japan with occupations and dates, within certain age limits

AUTHOR	DATE	OCCUPATION	AGE	NO.	RANGE (*cm.*)	$M \pm m$ (*cm.*)	σ (*cm.*)	V
Takeuchi (10)	1932	16 different occupations	19-30	4247	133-166	149.2 ± 0.08	5.05	3.39
Takeuchi (10)	1932	Mental workers	19-30	1524	138-166	151.1 ± 0.12	5.01	3.32
Takeuchi (10)	1932	Mental and phys. workers	19-30	1354	133-164	149.0 ± 0.13	4.77	3.20
Takeuchi (10)	1932	Physical workers	19-30	1369	133-162	147.1 ± 0.13	4.81	3.27
Dept. of Education (20)	1930	Student	23-24	....	.....	150.1	...	...
Dept. of Interior (23)	1929	Farm women	19-30	11283	.....	146.1	...	...
Matsuura (9)	1925	Student	18-30	2000	.....	149.9 ± 0.09	...	...
Tahara (21)	1924	Gen. pop.	19	248	.....	150.3	...	...
Into (24)	1913	Gen. pop.	...	....	.....	146.6	...	...
Miwa (25)	1901	Student	21-30	125	.....	146.0	...	...

were reared and is not simply a phenomenon of selection, as has been thought heretofore by many. Increase in stature is a world phenomenon. This increase is probably more striking in Japan than in Europe or America. It has been estimated that the stature of Japanese women in Japan has increased about 3 cm. during the period of the last 30 years. If the effect of environment on growth is the same in both countries then the stature of both groups, the U.S.A. and the U.S.-Japan, would be expected to be equal. Instead, there is such a distinct difference as is found in this study.

Another fact which is of interest to us is that this marked increase in stature of Group U.S.A. is 3.1 times that of the newborn infants of Japanese parents in the United States, which was 497 mm. (6-b). This growth rate from birth to maturity is identically the same as that of Japanese women in Japan proper (Yoshida, 22-a) and would indicate that the average stature of Japanese women may vary under the effect of different environments but the racial characteristic growth rate (birth to maturity) is not altered. The fact that Group U.S.-Japan has failed to attain its normal growth rate—3.56 instead of 3.1—indicates that the change in environment during the course of growth may affect normal body growth.

Comparable data for groups of women of different races in the United States are given in Table 8 to show racial differences in stature. It is noted that the Japanese women, even born and reared in the United States, are still the shortest among these groups.

Sitting-height (Table 9)

Mean of Group U.S.A., 848.80 ± 1.51 mm.; range = 775-912 mm., σ = 26.16 mm. (V = 3.08 ± 0.013) and mean index, $\frac{S.\text{-}h. \times 100}{L}$ 55.12 ± 0.098; σ = 1.10 ± 0.07 (V = 2.00 ± 0.08). In Group U.S.-Japan it is 839.60 ± 1.74 mm.; range = 767-916 mm., σ = 28.90 ± 1.23 mm. (V = 3.44 ± 0.01) with the mean index, 55.30 ± 0.115 mm.; σ = 1.25 ± 0.08 mm. (V = 2.26 ± 0.00) and for Group Japan it is 829.42 ± 1.35 mm.; range = 772-907 mm., σ = 24.60 ± 0.96 mm. (V = 2.98 ± 0.023) with the mean index, 55.37 ± 0.09; σ = 1.10 ± 0.064 (V = 1.99 ± 0.02).

TABLE 8

Average stature of American women by races with occupation, within limited age

RACE	INVESTIGATOR	DATE REPORTED	OCCUPATION	AGE (*Year*)	NO.	$M \pm P.E.$ (*mm.*)	σ (*mm.*)	V
American white women	Bayer and Gray (26)	1934	Working women	36.2	100	1615.45 ± 4.17	61.77	3.82
	Hooton (27)	1933	All occupations	20-34	1073	1623.9 ± 1.2	59.4	3.68
	Gould (3)	1933	Newcomb College	.....	3901	1613.92	....	...
	Carter (28)	1930	Tennessee Univ.	19	204	1621.9	56.7	3.54
	Jackson (29)	1929	Minnesota Univ.	19-56	1019	1616.9 ± 1.2	56.95	3.52
	Steggerda *et al.* (30)	1929	Smith College	17-24	100	1628.05 ± 3.75	55.59	3.42
	Hrdlička (13-b)	1925	Old Americans	20-29	73	1625.7	....	...
	Wilder and Pfeiffer (31)	1924	Smith College	17-27	100	1638	54.60	3.33
	Mosher (32)	1921	Stanford Univ.	.....	299	1625.6	....	...
American Negress	Hrdlička (13-c)	1928	Servants	20	6	1579	....	...
Indian Women on Pacific Coast	Boas (1-c)	1895	So. Cal. Mission	20-60	134	1693	....	...
	Boas (1-b)	1891	Central Oregon	20-50	6	1567 ± 3.8	....	...
	Boas (1-b)	1891	Harrison Lake	20-50	9	1522 ± 24	....	...
	Boas (1-b)	1891	Bilqula	20-50	6	1568 ± 19	....	...

TABLE 9

Sitting height: Showing range frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		775-912			767-916			772-907		
FREQUENCY DISTRIBUTION	Classes grouped in 10mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	760-769	..	...	...	1	.8	.8	..	...	...
	770-779	2	1.5	1.5	..	...	.8	2	1.3	1.3
	780-789	2	1.5	3.0	2	1.6	2.4	4	2.7	4.0
	790-799	2	1.5	4.5	6	4.8	7.2	11	7.3	11.3
	800-809	4	3.0	7.5	7	5.6	12.8	17	11.3	22.7
	810-819	12	8.9	16.3	16	12.8	25.6	17	11.3	34.0
	820-829	9	6.7	23.0	11	8.8	34.4	21	14.0	48.0
	830-839	23	17.0	40.0	16	12.8	47.2	13	8.7	56.7
	840-849	19	14.1	54.1	20	16.0	63.2	33	22.0	78.7
	850-859	12	8.9	63.0	14	11.2	74.4	17	11.3	90.0
	860-869	22	16.3	79.3	9	7.2	81.6	8	5.3	95.3
	870-879	16	11.8	91.1	12	9.6	91.2	4	2.7	98.0
	880-889	6	4.4	95.5	5	4.0	95.2	1	.7	98.7
	890-899	2	1.5	97.0	5	4.0	99.2	..	...	98.7
	900-909	3	2.2	99.3	..	...	99.2	2	1.3	100.0
	910-919	1	.7	100.0	1	.8	100.0	..	...	...
	Total	135	100.0		125	100.0		150	99.9	
STATISTICAL CONSTANTS										
Absolute	$M \pm P.E.$		848.80 ± 1.51			839.60 ± 1.74			829.42 ± 1.35	
	$\sigma \pm P.E.$		26.16 ± 1.07			28.90 ± 1.23			24.60 ± 0.96	
	$V \pm P.E.$		3.08 ± 0.013			3.44 ± 0.01			2.98 ± 0.023	
Relative	$M \pm P.E.$		55.12 ± 0.098			55.30 ± 0.115			55.37 ± 0.09	
	$\sigma \pm P.E.$		1.10 ± 0.07			1.25 ± 0.08			1.10 ± 0.064	
	$V \pm P.E.$		2.00 ± 0.08			2.26 ± 0.00			1.99 ± 0.02	
	DIFFERENCE BETWEEN		U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.	
Absolute	$M \pm P.E.$		−9.2 ± 2.31			−10.18 ± 2.20			+19.38 ± 2.02	
	$\sigma \pm P.E.$		+2.74 ± 1.63			− 4.30 ± 1.50			+ 1.56 ± 1.43	
	$V \pm P.E.$		+0.36 ± 0.01			− 0.46 ± 0.02			+ 0.10 ± 0.01	
Relative	$M \pm P.E.$		+0.18 ± 0.152			+ 0.07 ± 0.143			− 0.25 ± 0.133	
	$\sigma \pm P.E.$		+0.15 ± 0.10			− 0.15 ± 0.10			+ 0.0 ± 0.09	
	$V \pm P.E.$		+0.26 ± 0.08			− 0.27 ± 0.02			+ 0.01 ± 0.08	

Mean of Group U.S.A. is 9.2 mm. higher than that of Group U.S.-Japan and 19.4 mm. higher than that of Group Japan, giving a difference of 10.8 mm. between the last groups. The difference in mean index between each group is smaller than twice its probable error and is probably not statistically significant. This means that there is a proportionate increase in absolute sitting height as mean stature increases with an inversely proportionate decrease of mean index in each group. The average sitting-height of the limited number group, Group Japan-U.S. is 856 mm. with the index 55.61, which is the highest among all the groups in the study.

Variability in Group U.S.-Japan exceeds that of Group U.S.A. by 0.36 ± 0.01 in the absolute measurement and by 0.26 ± 0.08 in the index. It also exceeds that of Group Japan by 0.46 ± 0.02 in the absolute measurement and by 1.05 ± 0.19 in the index. Variability of Group U.S.A. is 0.10 ± 0.01 more than that of Group Japan in the absolute and only 0.01 ± 0.08 in the index, which is not statistically significant.

Sitting-height and its relation to stature differ racially, sexually, and by age, especially during the growth periods, and according to stature and type. It is not only the most useful and important measurement in anthropometry but also in the study of physiological function (Dregar), for school hygiene (Toyota), application in nutrition (V. Pirque) (31), etc. The studies of Bean (34) and later by Bardeen (35) in this country present very instructive treatises on the subject. One of the most characteristic features of body form of the Japanese as a race, when compared with others, is the relatively higher trunk and shorter lower extremities. According to Takeuchi's (10-a) study, the representative sitting-height for matured (19-30 years) Japanese women in Japan proper is 82.8 ± 0.04 cm. with σ of 2.83 ($V = 3.42$) and its mean index 55.4 ± 0.02 with σ of 1.37 ($V = 2.47$). She found that there is an average increase of 1.3 cm. as the stature increases every 3 cm. with an average decrease of 0.2 in index. In her stature class of 150 cm. the average sitting-height was 84.3 cm. with the index 55.2, and in 153 cm. class it was 84.3 cm. with the index 55.2, which is almost identically the same as it is in the nearest corresponding groups in the present study (Table 10). Yagi's (36) result from the factory girls (age = 19-20) was 80.7 ± 0.13 cm. with an index 55.0—nearly the same as that of Group U.S.A. From these facts it is apparent that the sitting-height of Japanese women

TABLE 10

Comparison between average sitting-heights of various groups of matured (18-30 years) Japanese women by stature, in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean stg.-ht.	Index to stature	Mean stature	Mean stg.-ht.	Index to stature	Group
(149) 150 (151)	82.9	55.4	149.7	82.9	55.4	Japan
(152) 153 (154)	84.3	55.2	151.9 154.0	84.0 84.9	55.3 55.1	U.S.-Japan U.S.A.

in the changed environment has so developed that it is directly proportionate to the stature but with an inversely proportional index. The effect is that their racial characteristic body form of high sitting-height is not altered with the marked increase in stature attained in the new environment in which they were born and reared.

Comparable data for various groups of different races in the United States are shown in Table 11. American Negresses have, on the average, relatively the lowest sitting-height among the groups, for American white women and North Pacific Coast Indian women it is slightly higher but is decidedly lower than for Japanese women when compared to stature.

Height of trochanter (Table 12)

Mean of Group U.S.A., 778.82 ± 2.16 mm.; range = 681-900 mm., σ = 37.35 ± 1.53 mm. (V = 4.80 ± 0.20); and mean index, 50.58 ± 0.14; σ = 1.58 ± 0.1 (V = 3.12 ± 0.13). In Group U.S.-Japan it is 767.40 ± 2.60 mm.; σ = 43.75 ± 1.87 mm. (V = 5.70 ± 0.24); and mean index, 50.52 ± 0.17; σ = 1.89 ± 0.123 mm. (V = 3.75 ± 0.16), and that for Group Japan it is 752.70 ± 1.60 mm.; range = 677-838 mm., σ = 30.0 ± 1.20 mm. (V = 4.04 ± 0.16) with mean index, 50.28 ± 0.11; σ = 1.36 ± 0.08 (V = 2.70 ± 0.11).

Mean of Group U.S.A. is 11.4 mm. higher than that of Group U.S.-Japan and 26.12 mm. higher than that of Group Japan which is 14.7 mm. lower than that of Group U.S.-Japan. The difference between the relative measurements in each group is so slight that it

TABLE 11

Average sitting-heights of various groups of women in different races in the United States, within certain age limits

RACE	INVESTIGATORS	DATE	SUBJECT	AGE (*Year*)	NO.	SITTING-HEIGHT			INDEX			STATURE (*mm.*)
						$M \pm P.E.$ (*mm.*)	σ	V	$M \pm P.E.$	σ	V	
American white women	Hooton	1933	Native American	20-34	1075	869.5 ± 0.6	31.5	3.62	53.05	...	...	1623.9
	Bayer and Gray	1934	Working women	36	100	855.05 ± 1.97	29.23	3.42	52.99 ± 0.09	1.30	2.45	1615.5
	Jackson	1929	Minn. women	19.6	1008	843.49 ± 0.67	31.64	3.75	52.2	...	...	1616.9
	Steggerda *et al.*	1929	Smith College students	20.15	100	868.40 ± 2.00	29.63	3.41	53.28 ± 0.88	1.31	2.46	1628.1
	Hrdlička	1925	Old Americans	24	25	.....	....	...	53.42	...	...	.....
	Wilder and Pfeiffer	1924	Smith College students	20.4	100	864.49	27.90	3.23	52.7	...	...	1638.0
American Negresses	Hrdlička	1928	Maids	19-25	6	77.9 cm.	....	...	51.7	...	...	157.9 cm.
American Indian women on Pacific Coast	Boas	1891	Indian women in central Oregon	20-50	6	858 ± 1.3	....	...	54.8	...	...	1567
	Boas	1891	Harrison Lake, Washington	20-50	9	808 ± 20	....	...	53.1	...	...	1522
	Boas	1891	Bilqula	20-50	6	850 ± 23	....	...	54.4	...	...	1568
	Boas	1895	So. Cal. Mission Indian	18.5	4	841.2	....	...	53.2	...	...	1584

TABLE 12

Height of trochanter: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		681-900			651-920			677-838		
FREQUENCY DISTRIBUTION	Classes grouped in 20mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	650-669	..	...	...	3	2.4	2.4	1	.7	.7
	670-689	1	0.7	0.7	1	0.8	3.2	1	.7	1.3
	690-709	3	2.2	2.9	9	7.2	10.4	12	8.0	9.3
	710-729	4	3.0	5.9	10	8.0	18.4	36	24.0	33.3
	730-749	21	15.6	21.5	18	14.4	32.8	37	24.7	58.0
	750-769	20	14.8	36.3	27	21.6	54.4	39	26.0	84.0
	770-789	25	18.5	54.8	20	16.0	70.4	14	9.3	93.3
	790-809	29	21.5	76.3	19	15.2	85.6	6	4.0	97.3
	810-829	18	13.3	89.6	10	8.0	93.6	4	2.7	100.0
	830-849	11	8.1	97.8	6	4.8	98.4	..	...	...
	850-869	1	0.7	98.6	1	0.8	99.2	..	...	...
	870-889	1	0.7	99.3	..	...	99.2	..	...	...
	890-909	1	0.7	100.0	..	...	99.2	..	...	...
	910-929	..	...	...	1	0.8	100.0	..	...	...
	Total	135	100.1		125	100.0		150	100.1	
STATISTICAL CONSTANTS Absolute	$M \pm P.E.$	778.82 ± 2.16			767.40 ± 2.60			752.70 ± 1.60		
	$\sigma \pm P.E.$	37.35 ± 1.53			43.75 ± 1.97			30.00 ± 1.20		
	$V \pm P.E.$	4.80 ± 0.20			5.70 ± 0.24			4.04 ± 0.16		
Relative	$M \pm P.E.$	50.58 ± 0.14			50.52 ± 0.17			50.28 ± 0.11		
	$\sigma \pm P.E.$	1.58 ± 0.1			1.89 ± 0.123			1.36 ± 0.08		
	$V \pm P.E.$	3.12 ± 0.13			3.75 ± 0.16			2.70 ± 0.11		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
Absolute	$M \pm P.E.$	− 11.42 ± 3.30			− 14.70 ± 3.06			+ 26.12 ± 2.69		
	$\sigma \pm P.E.$	+ 6.40 ± 2.42			− 13.75 ± 2.22			+ 7.35 ± 1.95		
	$V \pm P.E.$	+ 0.90 ± 0.31			− 1.66 ± 0.29			+ 0.76 ± 0.25		
Relative	$M \pm P.E.$	− 0.06 ± 0.22			− 0.24 ± 0.163			+ 0.30 ± 0.198		
	$\sigma \pm P.E.$	+ 0.31 ± 0.16			− 0.53 ± 0.15			+ 0.22 ± 0.13		
	$V \pm P.E.$	+ 0.63 ± 0.21			− 1.05 ± 0.19			+ 0.42 ± 0.17		

is not larger than twice its probable error and it is probably not statistically significant. The average height of trochanter of Group Japan-U.S. is 770.1 mm., which is the next highest to that of Group U.S.A. in the entire group, but the index which is 50.00 is the smallest.

The dispersion is greatest in Group U.S.-Japan and least in Group Japan in both absolute and relative measurements, the difference between the groups being 1.66 in mean and 1.05 in the index. The differences between Group U.S.A. and the other groups are slight with little statistical significance.

There are no data in Japanese literature comparable to the records of the present study since most Japanese workers use other methods of measuring the lower extremities, namely, the distance between the tip of the iliospinale and sole minus a certain length according to stature of the subject. According to Takeuchi the leg length of Japanese women increases an average of 1.5 cm. (from 0.9 to 2.6 cm.) as the stature increases every 3 cm. She found no proportionate increase in the relative measurements, contrary to Martin's (10-a) statement that there was a certain proportionate increase of average relative leg length as the average stature increased in each different group of men or women, with which the result in this study agrees. This suggests that the growth of the lower extremities of Japanese women, who were reared in the United States, is slightly more than it is in Japan.

In the United States the only comparable data available are Wilder and Pfeiffer's (31) figures on Smith College students. In their results the mean was 886.99 mm. with the σ 38.6 mm. ($V = 4.42$) and an index of 53.0 which is about 2.5 larger than that of Group U.S.A. It is a well-known fact that the white race, in general, has a relatively shorter trunk and longer lower extremities, while in the Japanese it is quite the reverse, and it is the most distinct characteristic difference between the two races. This very characteristic body proportion of Japanese women, even when they were born and reared in a different environment, natural and social, has not been shown to be altered in this study.

Span (Table 13)

Mean of Group U.S.A., 1531.4 ± 3.24 mm.; range = 1376-1680 mm., $\sigma = 55.90 \pm 2.99$ mm. ($V = 3.65 \pm 0.15$) and its mean index,

99.44 ± 0.21; σ = 2.34 ± 0.149 (V = 2.35 ± 0.10). In Group U.S.-Japan it is 1513.0 ± 3.62 mm.; range = 1351-1720 mm., σ = 60.15 ± 2.57 mm. (V = 3.98 ± 0.21) and its mean index, 99.59 ± 0.238; σ = 2.59 ± 0.169 (V = 2.60 ± 0.14). For Group Japan, it is 1501.0 ± 3.17 mm.; range = 1381-1680 mm.; σ = 57.60 ± 2.25 mm. (V = 3.84 ± 0.15) and its mean index, 100.2 ± 0.21; σ = 2.57 (V = 2.56 ± 0.10). Average span of Group Japan-U.S. is 1526.7 with index, 99.16, which is relatively the smallest in all the groups in this study.

Mean of Group U.S.A. exceeds that of Group U.S.-Japan by 18.4 mm. but in the mean indexes there is no significant difference. Group U.S.-Japan exceeds Group Japan by 12 mm. but the mean indexes do not have statistically significant differences. Mean of Group Japan is exceeded by Group U.S.A. by 30.4 mm., while its mean index is slightly larger (0.76 ± 0.30) than the latter and is statistically of little significance.

Variability is greatest in Group U.S.-Japan and least in Group U.S.A. but the differences between each group in both absolute and relative measurements are so slight that they are not statistically significant.

Span varies racially, sexually and by age according to stature and is influenced by occupation. When compared to the length of the trunk or body, it is a character of both phylogenetic and ontogenetic significance. Takeuchi's (10-b) figure for representative span of matured (19-30 years) Japanese women in Japan proper with average stature of 149.2 cm. is 148.4 ± 0.08 cm. with the index of 99.4 ± 0.04. According to her study, the span of Japanese women increases, on the average, 2.2-3 cm. every time the stature rises 3 cm. with decrease in index, 0.1 to 0.5. The average span in the various groups in this study appears to be slightly larger when compared with Takeuchi's corresponding stature class (Table 14).

Comparable data for various groups of different races in the United States are shown in Table 15. It appears that the average span of American white women is relatively larger than that of Japanese women. Those of American Negresses and Pacific Coast Indian women are shown to be decidedly larger than any other race in this study.

TABLE 13

Span: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		1376-1680			1351-1720			1381-1680		
FREQUENCY DISTRIBUTION	Classes grouped in 20mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	1340-1359	..	...	...	2	1.6	1.6	..	...	...
	1360-1379	1	0.7	0.7	1	.8	2.4	..	...	...
	1380-1399	..	...	0.7	3	2.4	4.8	2	1.3	1.3
	1400-1419	2	1.5	2.2	7	5.6	10.4	8	5.3	6.7
	1420-1439	6	4.4	6.6	6	4.8	15.2	10	6.7	13.3
	1440-1459	9	6.7	13.3	11	8.8	24.0	19	12.7	26.0
	1460-1479	7	5.3	18.6	7	5.6	29.6	17	11.3	37.3
	1480-1499	14	10.4	29.0	9	7.2	36.8	22	14.7	52.0
	1500-1519	17	12.6	41.6	17	13.6	50.4	19	12.7	64.7
	1520-1539	16	11.8	53.4	17	13.6	64.0	18	12.0	76.7
	1540-1559	16	11.8	65.2	14	11.2	75.2	12	8.0	84.7
	1560-1579	15	11.1	76.3	10	8.0	83.2	8	5.3	90.0
	1580-1599	13	9.6	85.9	9	7.2	90.4	8	5.3	95.3
	1600-1619	8	5.9	91.8	4	3.2	93.6	4	2.7	98.0
	1620-1639	4	3.0	94.8	4	3.2	96.8	..	...	98.0
	1640-1659	4	3.0	97.8	1	.8	97.6	2	1.3	99.3
	1660-1679	3	2.2	100.0	..	...	97.6	1	.7	100.0
	1680-1699	..	...	...	2	1.6	99.2	..	...	...
	1700-1719	..	...	...	1	.8	100.0	..	...	...
	Total	135	100.0		125	100.0		150	100.0	
STATISTICAL CONSTANTS Absolute	$M \pm P.E.$	1531.40 ± 3.24			1513.00 ± 3.62			1501.00 ± 3.17		
	$\sigma \pm P.E.$	55.90 ± 2.99			60.15 ± 2.57			57.60 ± 2.25		
	$V \pm P.E.$	3.65 ± 0.15			3.98 ± 0.21			3.84 ± 0.15		
Relative	$M \pm P.E.$	99.44 ± 0.21			99.59 ± 0.238			100.20 ± 1.212		
	$\sigma \pm P.E.$	2.34 ± 0.149			2.59 ± 0.169			2.57 ± 0.15		
	$V \pm P.E.$	2.35 ± 0.10			2.60 ± 0.140			2.56 ± 0.10		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
Absolute	$M \pm P.E.$	− 18.40 ± 4.84			− 12.00 ± 4.82			+ 30.40 ± 4.52		
	$\sigma \pm P.E.$	+ 4.25 ± 3.44			− 2.55 ± 3.42			− 1.70 ± 3.36		
	$V \pm P.E.$	+ 0.33 ± 0.26			− 0.14 ± 0.26			− 0.19 ± 0.21		
Relative	$M \pm P.E.$	+ 0.15 ± 0.316			+ 0.61 ± 0.318			− 0.76 ± 0.30		
	$\sigma \pm P.E.$	+ 0.25 ± 0.25			− 0.02 ± 0.25			− 0.23 ± 0.21		
	$V \pm P.E.$	+ 0.25 ± 0.17			− 0.04 ± 0.17			− 0.21 ± 0.10		

TABLE 14

Comparison between average spans of various groups of matured (18-30 years) Japanese women by stature in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean span	Index to stature	Mean stature	Mean span	Index to stature	Group
(149)						
150	149.2	99.4	149.7	150.1	100.2	Japan
(151)						
(152)			151.9	151.8	99.6	U.S.-Japan
153	151.7	99.2				
(154)			154.0	153.6	99.4	U.S.A.

Bi-acromial diameter (Table 16)

Mean of Group U.S.A., 352.15 ± 0.83 mm.; range = 324-394 mm., σ = 14.28 ± 0.59 mm. (V = 4.06 ± 0.17); its mean index, 22.87 ± 0.05; σ = 0.60 ± 0.04 (V = 2.64 ± 0.11). In Group U.S.-Japan it is 349.22 ± 0.90 mm.; range = 312-381 mm., σ = 14.88 ± 0.63 mm. (V = 4.27 ± 0.02); its mean index 23.00 ± 0.059; σ = 0.64 ± 0.42 (V = 2.81 ± 0.01) and for Group Japan, it is 348.83 ± 0.87 mm.; range = 305-383 mm., σ = 15.77 ± 0.61 mm. (V = 4.51 ± 0.18); and its mean index, 23.28 ± 0.058; σ = 0.71 ± 0.041 (V = 3.03 ± 0.12).

The mean of Group U.S.A. is 2.93 ± 1.22 mm. larger than that of Group U.S.-Japan but 0.13 ± 0.077 smaller in the index which is not statistically significant. It is 3.32 ± 1.20 mm. larger than that of Group Japan, while 0.41 ± 0.076 smaller in the index. Means of Groups U.S.-Japan and Group Japan are practically the same, while the index of the former is 0.28 ± 0.083 smaller than that of the latter. The mean of Group Japan-U.S. is 343.1 mm. and its index is 22.3—the smallest among all the groups in the study.

The differences in dispersion in both statistical constants, absolute and relative measurements, are so slight that there is little statistical significance.

Bi-acromial diameter varies by race, sex, occupation, age, stature, etc. It is one of the most significant indexes to denote the lateral development of physique. The representative bi-acromial diameter for matured Japanese women (19-30 years) in Japan proper by Take-

TABLE 15

Average span of various groups of women in different races in the United States with age, occupation and stature by different investigators

RACE	INVESTIGATORS AND DATE		SUBJECT	AGE	NO.	SPAN (*mm.*)			INDEX TO STATURE			STATURE (*mm.*)
						$M \pm P.E.$ (*mm.*)	σ (*mm.*)	V	$M \pm P.E.$	σ	V	
American white women	Hooton	1933	Century Progress Visitors	20-34	1070	162.03 ± 0.15cm.	7.20cm.	4.44	99.78	...	...	162.30cm.
	Steggerda *et al.*	1929	Smith College	20.15	100	1640.25 ± 4.52	67.04	4.09	99.41 ± 1.00	1.48	1.49	1628.05
	Wilder and Pfeiffer	1924	Smith College	20.4	100	1647.40	59.00	3.58	101.00	2.22	2.20	1638.0
	Tousley (37)	1927	P.O.A.	19.0	350	1623.8 ± 0.688	68.8	4.24	99.3	2.23	2.25	163.7cm.
	Hrdlička	1925	"Old American"	24.0	25	162.3cm.	....	...	99.57	...	...	164.5cm.
American Negress	Hrdlička	1928	Maids	22.3	3	164.8cm.	....	...	103.8	...	...	158.8cm.
Pacific Coast Indian women	Boas	1895	So. Cal. Indian	18.5	4	1638.8	....	...	104.9	...	...	1584
	Boas	1891	Central Oregon	20-50	6	1613 ± 48	....	...	102.9 ± 12	...	...	1567
	Boas	1891	Harrison Lake	20-50	9	1568 ± 50	....	...	104.5 ± 12	...	...	1522
	Boas	1891	Bilqula	20-50	6	1655 ± 45	....	...	105.9 ± 12	...	...	1568

TABLE 16

Bi-acromial diameters: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		324-394			312-381			305-373		
FREQUENCY DISTRIBUTION	Classes grouped in 10mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	300-309	..	...	...	..	...	...	1	.7	.7
	310-319	..	...	...	2	1.6	1.6	5	3.3	4.0
	320-329	4	3.0	3.0	11	8.8	10.4	13	8.7	12.7
	330-339	20	14.8	17.8	19	15.2	25.6	27	18.0	30.7
	340-349	36	26.7	44.4	28	22.4	48.0	32	21.3	52.0
	350-359	35	25.9	70.4	33	26.4	74.4	41	27.3	79.3
	360-369	27	20.0	90.4	20	16.0	90.4	19	12.7	92.0
	370-379	9	6.7	97.0	11	8.8	99.2	9	6.0	98.0
	380-389	3	2.2	99.3	1	.8	100.0	3	2.0	100.0
	390-399	1	.7	100.0	..	...	...	..	...	...
	Total	135	100.0		125	100.0		150	100.0	

STATISTICAL CONSTANTS				
Absolute	$M \pm P.E.$	352.15 ± 0.83	349.22 ± 0.90	348.83 ± 0.87
	$\sigma \pm P.E.$	14.28 ± 0.59	14.88 ± 0.63	15.77 ± 0.61
	$V \pm P.E.$	4.06 ± 0.17	4.27 ± 0.02	4.54 ± 0.18
Relative	$M \pm P.E.$	22.87 ± 0.05	23.00 ± 0.059	23.28 ± 0.058
	$\sigma \pm P.E.$	0.60 ± 0.04	0.64 ± 0.042	0.71 ± 0.041
	$V \pm P.E.$	2.64 ± 0.11	2.81 ± 0.01	3.03 ± 0.12
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN	U.S.-JAPAN-JAPAN	JAPAN-U.S.A.
Absolute	$M \pm P.E.$	-2.93 ± 1.22	-0.39 ± 1.25	$+3.32 \pm 1.20$
	$\sigma \pm P.E.$	$+0.60 \pm 0.86$	$+0.89 \pm 0.88$	-1.49 ± 0.85
	$V \pm P.E.$	$+0.20 \pm 0.17$	-0.48 ± 0.25	$+0.28 \pm 0.18$
Relative	$M \pm P.E.$	$+0.13 \pm 0.077$	$+0.28 \pm 0.083$	-0.41 ± 0.076
	$\sigma \pm P.E.$	$+0.04 \pm 0.058$	$+0.07 \pm 0.059$	-0.11 ± 0.057
	$V \pm P.E.$	$+0.17 \pm 0.11$	$+0.22 \pm 0.12$	-0.39 ± 0.16

uchi (10-b) is 33.7 ± 0.02 cm. with the index 22.6 ± 0.01. She found that there was an average increase of 0.3-0.4 cm. as the stature increased every 3 cm., with a decrease of the index of 0.2. In comparison with Takeuchi's average bi-acromial diameters by stature class, respectively, (Table 17), both Group U.S.-Japan and Group

TABLE 17

Comparison between average bi-acromial diameters of various groups of matured Japanese women (18-30 years) by stature in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean bi-acromial diameter	Index to stature	Mean stature	Mean bi-acromial diameter	Index to stature	Group
(149) 150 (151)	33.7	22.5	149.7	34.9	23.3	Japan
(152) 153	34.0	22.3	151.9	34.9	23.0	U.S.-Japan
(154)			154.0	35.2	22.9	U.S.A.

U.S.A. exceed about 10 mm. in the absolute and about 0.6 in the index. Yagi's (36) result from the factory girls (age = 19-22) was 32.7 cm. with an index of 22.1. Yoshida's (22-b) figure from athletes was 34.6 cm. with the index, 23.0. These facts indicate that the average bi-acromial diameter of American-born Japanese women is significantly larger than that of Japanese women in Japan proper.

Comparable data for various groups of American white women, chiefly college women, are shown in Table 18. Students usually have smaller, or the smallest, bi-acromial diameter when compared with groups in other occupations. Bayer and Gray's (26) working women, being composed of individuals whose ages are so different (20-50 yrs.), cannot justifiably be used for purposes of comparison. The average bi-acromial diameter of 4 Southern California Mission Indians (stature = 1584 mm.), according to Boas, was 362.7 mm. with an average index of 22.9, which is nearly the same as that of Group U.S.A.

Bi-cristal diameter (Table 19)

Mean of Group U.S.A., 282.63 ± 0.79 mm.; range = 255-517 mm., σ = 13.57 ± 0.56 mm. (V = 4.80 ± 0.20); mean index, 18.35

TABLE 18

Average bi-acromial diameters of various groups of American white women with stature and occupation, in limited age

AUTHOR AND MATERIAL	AGE	NO.	BI-ACROMIAL BREADTH (*mm.*)			REL. BI-ACROM. BREADTH			STATURE (*mm.*)
			$M \pm P.E.$ (*mm.*)	σ (*mm.*)	V	$M \pm P.E.$	σ	V	
Wilder and Pfeiffer Smith College	17-27	100	352.39	17.25	4.90	21.5	...	...	1638.0
Steggerda *et al.* Smith College	17-24	100	356.05 ± 1.02	15.11	4.24	21.87	...	...	1628.1
Bayer and Gray Working women	20-50 (36.2)	190	355.45 ± 0.65	13.67	3.85	22.02 ± 0.06	0.89	4.04	1615.5
Bowles: All college									
Mothers	18-19.5	372	367.5	18.2	4.95	22.74	...	...	1616.0
Daughters	17.5-18	162	368.9 ± 1.0	18.3	5.10	22.42	...	...	1645.3

$\pm$ 0.05; σ = 0.57 $\pm$ 0.04 (V = 3.12 $\pm$ 0.13). In Group U.S.-Japan it is 284.32 $\pm$ 1.02 mm.; range = 250-330 mm., σ = 16.90 $\pm$ 0.72 mm. (V = 5.94 $\pm$ 0.25); mean index, 18.72 $\pm$ 0.067; σ = 0.73 $\pm$ 0.047 (V = 3.91 $\pm$ 0.16) and for Group Japan, it is 261.60 $\pm$ 0.57 mm.; range = 230-308, σ = 10.37 $\pm$ 0.40 mm. (V = 3.97 $\pm$ 0.12) and mean index, 17.47 $\pm$ 0.034; σ = 0.46 $\pm$ 0.027 (V = 2.65 $\pm$ 0.08).

The difference between the means of Group U.S.A. and Group U.S.-Japan is so slight that it is not statistically significant, while in that of mean index, the latter exceeds the former by 0.37 $\pm$ 0.084. Group Japan is 21.03 $\pm$ 0.97 mm. smaller in mean and 0.88 $\pm$ 0.061 in mean index than Group U.S.A., and 22.72 $\pm$ 1.17 mm. smaller in mean and 1.25 $\pm$ 0.075 in mean index than Group U.S.-Japan. The reason for the relatively greater hip breadth of Group U.S.-Japan when compared to Group U.S.A. is probably due to the fact that the former consists chiefly of married women and individuals who have borne children, while Group Japan has markedly smaller hip breadth, partly due to the fact that the group is composed chiefly of single women.

In comparison of variability, Group U.S.-Japan exceeds 1.14 $\pm$ 0.32 over Group U.S.A. and 1.97 $\pm$ 0.28 over Group Japan, while Group U.S.A. is 0.83 $\pm$ 0.23 greater than Group Japan in the absolute measurement. In the index, Group U.S.A. is 0.79 $\pm$ 0.21 smaller than Group U.S.-Japan and 0.47 $\pm$ 0.15 greater than Group Japan.

Average bi-cristal diameter of Group Japan-U.S. is 274 mm. with the index to stature 17.8, which is slightly larger than that of Group Japan and markedly smaller than the figures for Group U.S.A. and Group U.S.-Japan.

There are racial and sexual differences in bi-cristal diameter. It is influenced by childbirth, occupation, age, stature, etc. According to Takeuchi (10-b), the representative bi-cristal diameter for matured (19-30 years) Japanese women is 26.8 $\pm$ 0.02 cm. with an index of 18.0 $\pm$ 0.01. She found that there was an increase of 0.3-0.4 cm. in bi-cristal diameter as the stature increased every 3 cm., with a decrease of index by 0.1. In comparison with the nearest stature class of Takeuchi (Table 20), bi-cristal diameter of Group U.S.-Japan exceeds by about 13.0 mm. in the mean and about 0.6-0.7 in the index while Group U.S.A. is about 10 mm. greater in the mean and about 0.5 in the index. Yagi's (36) figures for factory girls were 26.1 cm.

TABLE 19

Bi-cristal diameter: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		255-317			250-330			230-308		
FREQUENCY DISTRIBUTION	Classes grouped in 10mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	230-239	..	...	...	..	...	...	2	1.3	1.3
	240-249	..	...	...	..	...	...	16	10.7	12.0
	250-259	3	2.2	2.2	5	4.0	4.0	34	22.7	34.7
	260-269	14	10.4	12.6	15	12.0	16.0	70	46.7	81.3
	270-279	40	29.6	42.2	23	18.4	34.4	23	15.3	96.7
	280-289	38	28.2	70.4	42	33.6	68.0	3	2.0	98.7
	290-299	20	14.8	85.2	22	17.6	85.6	..	...	98.7
	300-309	16	11.8	97.0	10	8.0	93.6	2	1.3	100.0
	310-319	4	3.0	100.0	5	4.0	97.6	..	...	...
	320-329	..	...	...	2	1.6	99.2	..	...	...
	330-339	..	...	...	1	.8	100.0	..	...	...
	Total	135	100.0		125	100.0		150	100.0	

STATISTICAL CONSTANTS				
Absolute	$M \pm P.E.$	282.63 ± 0.79	284.32 ± 1.02	261.60 ± 0.57
	$\sigma \pm P.E.$	13.57 ± 0.56	16.90 ± 0.72	10.37 ± 0.40
	$V \pm P.E.$	4.80 ± 0.20	5.94 ± 0.25	3.97 ± 0.12
Relative	$M \pm P.E.$	18.35 ± 0.05	18.72 ± 0.067	17.47 ± 0.034
	$\sigma \pm P.E.$	0.57 ± 0.04	0.73 ± 0.047	0.46 ± 0.027
	$V \pm P.E.$	3.12 ± 0.13	3.91 ± 0.16	2.65 ± 0.08
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN	U.S.-JAPAN-JAPAN	JAPAN-U.S.A.
Absolute	$M \pm P.E.$	$+ 1.69 \pm 1.29$	$- 22.72 \pm 1.17$	$+ 21.03 \pm 0.97$
	$\sigma \pm P.E.$	$+ 3.33 \pm 0.91$	$- 6.53 \pm 0.82$	$+ 3.20 \pm 0.69$
	$V \pm P.E.$	$+ 1.14 \pm 0.32$	$- 1.97 \pm 0.28$	$+ 0.83 \pm 0.23$
Relative	$M \pm P.E.$	$+ 0.37 \pm 0.084$	$- 1.25 \pm 0.075$	$+ 0.88 \pm 0.061$
	$\sigma \pm P.E.$	$+ 0.16 \pm 0.062$	$- 0.27 \pm 0.054$	$+ 0.11 \pm 0.048$
	$V \pm P.E.$	$+ 0.79 \pm 0.21$	$- 1.26 \pm 0.18$	$+ 0.47 \pm 0.15$

TABLE 20

Comparison between average bi-cristal diameters of various groups of Japanese women (18-30 years) by stature in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean bi-cristal diameter	Index to stature	Mean stature	Mean bi-cristal diameter	Index to stature	Group
(149) 150 (151)	26.9	18.0	149.7	26.2	17.5	Japan
(152)			151.9	28.4	18.7	U.S.-Japan
153	27.2	17.9				
(154)			154.0	28.3	18.4	U.S.A.

with the index 17.7. There are several other data given by different investigators which show slightly less or more than these data just given—ranging from 17.4 to 18.0 in the indexes. From these figures it is indicated that the American-born groups of Japanese women, on the average, have a wider bi-cristal diameter than have Japanese women in Japan proper.

Comparable data for other races in the United States besides the few groups of college students by Wilder and Pfeiffer (31), and Steggerda *et al.* (30), and of working women by Bayer and Gray (26) were obtainable. Most of these records, however, were for obstetrical purposes and are not from the anthropometrical standpoint. The author hesitates to make a comparison with any of them.

Head circumference (Table 22)

Mean of Group U.S.A., 542.40 ± 0.84 mm.; range = 511-570 mm., σ = 14.46 ± 0.59 mm. (V = 2.67 ± 0.11) and mean index, 35.22 ± 0.055 with σ = 0.61 ± 0.038 (V = 1.73 ± 0.07). In Group U.S.-Japan it is 538.54 ± 0.79 mm.; range = 510-575 mm., σ = 13.10 ± 0.56 mm. (V = 2.43 ± 0.10) and mean index, 35.46 ± 0.52; σ = 0.57 ± 0.037 (V = 1.60 ± 0.06). For Group Japan it is 542.00 ± 0.65 mm.; range = 510-570 mm., σ = 11.80 ± 0.46 mm. (V = 2.18 ± 0.84) and mean index, 36.20 ± 0.043; σ = 0.53 ± 0.031 (V = 1.46 ± 0.058).

Mean of group U.S.A. exceeds that of Group U.S.-Japan by 3.86 ± 1.15 mm. but it is almost identically the same as that of Group

TABLE 21

Average bi-cristal diameter for various groups of American white women with stature, within limited age

INVESTIGATOR	OCCUPATION	AGE (*Year*)	BI-CRISTAL DIAMETER			HEIGHT-CRISTAL INDEX			STATURE
			$M \pm P.E.$ (*mm.*)	σ (*mm.*)	V	$M \pm P.E.$	σ	V	
Steggerda *et al.*	Smith College students	20.15	248.95 ± 1.06	15.64	5.492	15.29	...	...	1628.1
Davenport and Steggerda	Smith College students	20.0	263.1 ± 3.2	....	...	16.39	...	...	1604.8
Wilder and Pfeiffer	Smith College students	17-27	272.34	18.80	6.90	16.6	...	...	1638.0
Bayer and Gray	Working women	36.2	301.15 ± 1.00	16.11	5.35	18.65 ± 0.06	0.94	5.04	1615.5

Japan. Mean index of Group Japan exceeds that of Group U.S.A. by 0.98 ± 0.069 and that of Group U.S.-Japan by 0.74 ± 0.074. That of Group U.S.A. is 0.24 ± 0.082 smaller than that of Group U.S.-Japan. The difference in the coefficient of variation between each group is not larger than twice its probable error and is not statistically significant. Mean head circumference of Group Japan-U.S. is 533.9 mm. with mean index of 34.7, which is the smallest in all the groups in this study.

Comparable data for Japanese women in Japan proper, other than for Group Japan, are shown in Table 23. The average of the limited number group by Miwa (25) is approximately the same as that of Group Japan in this study while that of women in Yamaguchi prefecture, by Miyake and Nakayama (40), is slightly larger than that of Group U.S.A. According to the study made by The Imperial University of Kyoto (40), there is a geographical difference in head circumference in Japan. In this study the head circumferences of the different groups of Japanese women do not show any appreciable degree of difference, suggesting that head circumference of Japanese women is stable, unlike stature or other parts of the body, under the effect of the different environment.

Comparable data for other races in the United States are very scarce. Average head circumference of 100 Smith College students (average age = 20.15 years) according to Steggerda *et al.* (30) was 550.15 mm. with standard deviation of 12.98 mm. (V = 2.36). Bowle's (38) figures for Old American College women (average age = 18.8 years) were 547.3 mm. with standard deviation, 13.8 (V = 2.52). They are moderately larger than the figures for average Japanese women, but when compared with stature they are decidedly smaller.

Thoracic circumference (Table 24)

Mean of Group U.S.A., 752.07 ± 2.79 mm.; range = 651-920 mm., σ = 48.20 ± 1.97 mm. (V = 6.40 ± 0.26) and its mean index to stature, 48.84 ± 0.181; σ = 2.03 ± 0.13 (V = 4.15 ± 0.17). In Group U.S.-Japan it is 772.69 ± 3.47 mm.; range = 651-1000 mm., σ = 57.60 ± 2.46 mm. (V = 7.47 ± 0.32) and its mean index to stature, 50.88 ± 0.228; σ = 2.50 ± 0.162 (V = 4.92 ± 0.21). For Group Japan, mean is 814.54 ± 2.94 mm.; range = 641-990; σ = 53.50 ± 2.09 mm. (V = 6.58 ± 0.26) and its mean index, 54.4 ± 0.196; σ = 2.42 ± 0.14 (V = 4.39 ± 0.17).

Unlike the measurements so far studied, the thoracic circumference is the greatest in Group Japan in both absolute and relative measurements. It exceeds Group U.S.A. by 62.47 mm. in the mean and 5.56 in the mean index. It is 41.85 mm. larger in the mean and 3.52 in

TABLE 22

Head circumference: Showing range, frequency distribution, statistical constants and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		511-570			510-575			510-570		
FREQUENCY DISTRIBUTION	Classes grouped in 10mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	510-519	2	1.5	1.5	5	4.0	4.0	2	1.3	1.3
	520-529	19	14.1	15.6	26	20.8	24.8	18	12.0	13.3
	530-539	30	22.2	37.8	38	30.4	55.2	43	28.7	42.0
	540-549	40	29.6	67.4	28	22.4	77.6	42	28.0	70.0
	550-559	29	21.5	88.9	17	13.6	91.2	31	20.7	90.7
	560-569	12	8.9	97.8	10	8.0	99.2	13	8.7	99.3
	570-579	3	2.2	100.0	1	.8	100.0	1	.7	100.0
	Total	135	100.0		125	100.0		150	100.1	
STATISTICAL CONSTANTS Absolute	$M \pm P.E.$	542.40 ± 0.84			538.54 ± 0.79			542.00 ± 0.65		
	$\sigma \pm P.E.$	14.46 ± 0.59			13.10 ± 0.56			11.80 ± 0.46		
	$V \pm P.E.$	2.67 ± 0.11			2.43 ± 0.10			2.18 ± 0.87		
Relative	$M \pm P.E.$	35.22 ± 0.055			35.46 ± 0.052			36.2 ± 0.043		
	$\sigma \pm P.E.$	0.61 ± 0.038			0.57 ± 0.037			0.53 ± 0.031		
	$V \pm P.E.$	1.73 ± 0.07			1.60 ± 0.06			1.46 ± 0.058		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
Absolute	$M \pm P.E.$	-3.86 ± 1.15			$+3.46 \pm 1.02$			$+0.40 \pm 1.06$		
	$\sigma \pm P.E.$	-1.36 ± 0.81			-1.30 ± 0.73			$+2.66 \pm 0.75$		
	$V \pm P.E.$	-0.24 ± 0.15			-0.25 ± 0.88			$+0.49 \pm 0.88$		
Relative	$M \pm P.E.$	$+0.24 \pm 0.082$			$+0.74 \pm 0.074$			-0.98 ± 0.069		
	$\sigma \pm P.E.$	-0.04 ± 0.053			-0.04 ± 0.048			$+0.08 \pm 0.049$		
	$V \pm P.E.$	-0.13 ± 0.09			-0.14 ± 0.08			$+0.27 \pm 0.09$		

TABLE 23

Circumference of head of Japanese women in Japan proper by different investigators

AUTHOR	YEAR REPORTED	AGE	NO.	$M \pm m$ (*mm.*)	$\sigma \pm m$	V	STATURE (*mm.*)
Miyake and Nakayama*	1937	Adult	99	543.74 ± 1.65	16.43 ± 1.19	3.02	1476.8
Miwa	1901	17-18	6	52.9 (*cm.*)	.....	...	.....
Miwa	1901	18-19	9	55.4 (*cm.*)	.....	...	.....
Miwa	1901	19-20	8	53.0 (*cm.*)	.....	...	.....

* Women of Yamaguchi Prefecture.

the mean index, respectively, than it is in Group U.S.-Japan. Mean of Group U.S.A. is exceeded by that of Group U.S.-Japan by 20.62 mm. and mean index by 2.04.

Variability is greatest in Group U.S.-Japan, in both absolute and relative measurements. It exceeds Group U.S.A. by 1.07 ± 0.41 in the mean and by 0.77 ± 0.27 in the index. It is 0.89 ± 0.41 greater in the mean and 0.53 ± 0.27 in the index, respectively, than it is in Group Japan, which is of little statistical significance. Differences between Group U.S.A. and Group Japan, in both absolute and relative measurements, are so slight that they are statistically insignificant.

Average thoracic circumference of Group Japan-U.S. is 733 mm. with index of 47.6, which is the smallest among all the groups in the study.

The thoracic circumference varies racially, sexually and by age, according to stature and is influenced by occupation. Brugsch (41) considered it the most important and useful measurement to denote

TABLE 25

Average thoracic circumference of Japanese women

INVESTIGATOR	NO.	OCCUPATION	$M \pm m$	INDEX TO STATURE
S. Takeuchi	715	15 different occupations	786 ± 0.17	52.6 ± 0.12
Department of Education		Student	79.7	53.0
Department of Interior	1126	Farm women	80.1	54.8
K. Yagi	72	Factory women	81.8	55.2

TABLE 24

Thoracic circumference: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm.*)		651-920			651-1000			641-990		
FREQUENCY DISTRIBUTION	Classes grouped in 20mm.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	650-669	2	1.5	1.5	1	.8	.8	1	.7	.7
	670-689	9	6.7	8.2	3	2.4	3.2	..	...	.7
	690-709	14	10.3	18.5	10	8.0	11.2	..	...	.7
	710-729	19	14.1	32.6	11	8.8	20.0	3	2.0	2.7
	730-749	25	18.5	51.1	31	24.8	44.8	7	4.6	7.3
	750-769	27	20.0	71.1	20	16.0	60.8	16	10.7	18.0
	770-789	15	11.1	82.2	13	10.4	71.2	9	6.0	24.0
	790-809	12	8.9	91.1	6	4.8	76.0	27	18.0	42.0
	810-829	5	3.7	94.8	8	6.4	82.4	15	10.0	52.0
	830-849	2	1.5	96.3	12	9.6	92.0	26	17.3	69.3
	850-869	2	1.5	97.7	4	3.2	95.2	19	12.6	82.0
	870-889	1	.7	98.5	3	2.4	97.6	11	7.3	89.3
	890-909	..	...	98.5	..	...	97.6	9	6.0	95.3
	910-929	2	1.5	100.0	1	.8	98.4	3	2.0	97.3
	930-949	..	...	...	1	.8	99.2	2	1.4	98.7
	950-969	..	...	...	..	...	99.2	1	.7	99.3
	970-989	..	...	...	..	...	99.2	..	...	99.3
	990-999	..	...	...	1	.8	100.0	1	.7	100.0
	Total	135	100.0		125	100.0		150	100.0	
STATISTICAL CONSTANTS	Absolute $M \pm P.E.$	752.07 ± 2.79			772.69 ± 3.47			814.54 ± 2.94		
	Absolute $\sigma \pm P.E.$	48.20 ± 1.97			57.60 ± 2.46			53.50 ± 2.09		
	Absolute $V \pm P.E.$	6.40 ± 0.26			7.47 ± 0.32			6.58 ± 0.26		
	Relative $M \pm P.E.$	48.84 ± 0.181			50.88 ± 0.228			54.40 ± 0.196		
	Relative $\sigma \pm P.E.$	2.03 ± 0.13			2.50 ± 0.162			2.42 ± 0.14		
	Relative $V \pm P.E.$	4.15 ± 0.17			4.92 ± 0.21			4.39 ± 0.17		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
	Absolute $M \pm P.E.$	+20.62 ± 4.45			+41.85 ± 4.55			—62.47 ± 4.06		
	Absolute $\sigma \pm P.E.$	+ 9.4 ± 3.16			— 4.1 ± 3.23			— 5.3 ± 2.87		
	Absolute $V \pm P.E.$	+ 1.07 ± 0.41			— 0.89 ± 0.41			— 0.18 ± 0.37		
	Relative $M \pm P.E.$	+ 2.04 ± 0.289			+ 3.52 ± 0.297			— 5.56 ± 0.267		
	Relative $\sigma \pm P.E.$	+ 0.47 ± 0.21			— 0.08 ± 0.21			— 0.39 ± 0.19		
	Relative $V \pm P.E.$	+ 0.77 ± 0.27			— 0.53 ± 0.27			— 0.24 ± 0.24		

the degree of lateral development of the body. Davenport (42) uses it for his formula $\left(\frac{\text{Chest circum.}}{\text{Stature}} \times 100\right)$ to designate the "body build" in his study. Comparable data for the various groups of Japanese women in Japan (age = 20 years) are given in Table 25.

According to Takeuchi's (10-c) study, the representative thoracic circumference for Japanese women of 15 different occupations in Japan proper is 78.8 ± 0.07 cm. with σ, 4.40 (V = 5.59), and the index, 52.8 ± 0.05, with σ 3.26 (V = 6.18). She found that the thoracic circumference of matured (19-30 years) Japanese women had increased 0.4-0.5 cm. as the stature increased every 3 cm. with a decrease of 0.7-1.0 in the relative measurement. In comparison with Takeuchi's average weights by ages (Table 26) it is apparent that the average thoracic circumference of Japanese women who were born

TABLE 26

Comparison between average thoracic circumferences of various groups of Japanese women by stature in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean thoracic circum.	Index to stature	Mean stature	Mean thoracic circum.	Index to stature	Group
(149) 150 (151)	78.8	52.5	149.7	81.5	54.4	Japan
(152) 153 (154)	79.2	51.7	151.9	77.3	50.9	U.S.-Japan
			154.0	75.2	48.8	U.S.A.

in the United States, especially that of Group U.S.A., is decidedly smaller than is that of Japanese women in Japan. It has been generally agreed by Japanese physicians here that the chest development of the Nisei women is comparatively poorer than it is of the Issei women here or women in Japan proper—and at the same time, that the majority of them are wanting in breast milk is also a well-known fact. Whether there is any relation between these two phenomena or not is not definitely determinable here, but the probability is that there will be a close connection between them. Hrdlička (13-b) states, "the Old

Americans, in general and normally, tend to be tall and slender. In men the slenderness is relatively unobtrusive and inconsequential, but in a good many of the women when it is marked, it is accompanied by subdevelopment of the chest and breast and constitutes, not seldom, esthetically as well as physiologically (capacity for nursing, etc.) more or less of a disadvantage."

It is the general rule that as the stature increases the body build tends to become slender. This tendency in the Nisei Japanese women is found to be a most marked one. It is my opinion, however, that this phenomenon is chiefly due to the unusually rapid increase in stature at the expense of the lateral development and would seem to be transitional in nature.

Comparable data available for the various groups of American white women, mostly college students, are shown in Table 27. It will be seen that the average thoracic circumference of American white working women is decidedly larger than it is for Japanese women in general, and even for the students it is also relatively larger than for Group U.S.A.

Body weight (Table 28)

Mean of Group U.S.A., 50.51 ± 0.41 kg.; range = 38.05-73.05 kg., σ = 7.05 ± 0.29 kg. (V = 13.95 ± 0.57) and mean Rohrer's index, 138.02 ± 1.021; σ = 17.60 ± 0.72 (V = 12.74 ± 0.52). In Group U.S.-Japan it is 50.91 ± 0.49 kg.; range = 37.32-75.82 kg., σ = 8.13 ± 0.35 kg. (V = 15.95 ± 0.68) and mean Rohrer's index, 145.7 ± 1.28; σ = 21.3 ± 0.90 (V = 14.62 ± 0.62). For Group Japan it is 51.71 ± 0.32 kg.; range = 35.05-67.55 kg., σ = 5.86 ± 0.23 kg. (V = 11.34 ± 0.44) and mean Rohrer's index, 156.55 ± 1.035; σ = 18.80 ± 0.73 (V = 12.02 ± 0.47).

The differences in the mean weight among the three groups are not large enough to be considered of any statistical significance. The mean Rohrer's index of Group Japan exceeds that of Group U.S.A. by 18.53 and that of Group U.S.-Japan by 10.85. Group U.S.A. is 7.68 smaller than Group U.S.-Japan. This is the second measurement (the first was the thoracic circumference) which shows that both measurements, absolute and relative, are greatest in Group Japan, smallest in Group U.S.A., with Group U.S.-Japan between the two. It is the general rule that the greater the thoracic circumference the heavier the body weight.

TABLE 27

Average thoracic circumference of American white women with stature, within limited age

INVESTIGATOR	OCCUPATION	AVERAGE AGE (year)	NO.	THORACIC CIRCUMFERENCE			REL. THORACIC CIRCUM.			STATURE (mm.)
				$M \pm P.E.$ (mm.)	σ (mm.)	V	$M \pm P.E.$	σ	V	
Steggerda	College women (Smith)	20.15	100	793.90 ± 2.47	36.55	4.60	48.69 ± 0.18	2.60	5.34	1628
Crane and Steele	College women (Minn. Univ.)	19.6	993	789.90 ± 1.00	47.72	6.042	48.9	...	...	1617
Jackson	Working women (California)	36.2	100	858.85 ± 3.66	54.30	6.32	53.15 ± 0.22	3.32	6.25	1615
Bayer and Gray	College women (Stanford)	16-29	430	827.0	....	...	51.2	...	...	1623
Pasmore and Weymouth										

The dispersion is greatest in Group U.S.-Japan, smallest in Group Japan, with that of Group U.S.A., the medium. The reason for the differences are given elsewhere in a previous study.

The average body weight for Group Japan-U.S. is 49.6 kg. with Rohrer's index 136.8. This group of limited number is shown to be the lightest among all the groups.

The body weight, except in the case of abnormal or pathological adiposity, is the most important mean to express the nutritional condition of man. This can be seen from the fact that all the nutritional indexes contain the body weight in the formula. (In this study Rohrer's (22-b) index, $\left(\frac{G\ (\text{body wt.}) \times 100}{L\ (\text{stature})^3}\right)$, was used, as it is thought to designate the body build and nutritional condition most conveniently.) Body weight varies with race and sex and is influenced by socio-economic condition, occupation and stature. The representative body weight for matured (19-30 years) Japanese women of 15 different occupations by Takeuchi (10-d) is 47.6 ± 0.09 kg. with a standard deviation of 6.13 kg., and Rohrer's index, 143.4 ± 0.28 with a standard deviation of 17.5. She found that the weight of Japanese women increases 1.3-1.8 kg. body weight as the stature increases every 3 cm. with a decrease of Rohrer's index by 4. In comparison with Takeuchi's average weights by stature class (Table 29), Group U.S.-Japan appears

TABLE 29

Comparison between average body weights of various groups of Japanese women by stature in different environments

TAKEUCHI			PRESENT STUDY			
Stature class	Mean weight	Rohrer's index	Mean stature	Mean weight	Rohrer's index	Group
(149)						
150	48.1	142.6	149.7	51.7	156.5	Japan
(151)						
(152)			151.9	50.9	145.7	U.S.-Japan
153	49.4	138.6				
(154)			154.0	50.5	138.0	U.S.A.

to weigh more than that of Takeuchi's nearest corresponding stature class while Group U.S.A. weighs about the same as that of her corresponding stature class.

TABLE 28

Body weight: Showing range, frequency distribution, statistical constant and difference between each group

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*kg.*)		38.047-73.046			37.321-75.820			35.047-67.546		
FREQUENCY DISTRIBUTION	Classes grouped in kg.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	34.000-35.999	..	...	...	..	...	...	1	.7	.7
	36.000-37.999	..	...	...	1	.8	.8	..	...	.7
	38.000-39.999	7	5.2	5.2	3	2.4	3.2	..	...	.7
	40.000-41.999	9	6.7	11.9	6	4.8	8.0	4	2.7	3.3
	42.000-43.999	12	8.9	20.7	18	14.4	22.4	8	5.3	8.7
	44.000-45.999	8	5.9	26.7	14	11.2	33.6	13	9.3	18.0
	46.000-47.999	21	15.6	42.2	16	12.8	46.4	19	12.0	30.0
	48.000-49.999	15	11.1	53.3	8	6.4	52.8	15	10.0	40.0
	50.000-51.999	18	13.3	66.7	10	8.0	60.8	21	14.0	54.0
	52.000-53.999	8	5.9	72.6	9	7.2	68.0	14	9.3	63.3
	54.000-55.999	12	8.9	81.5	8	6.4	74.4	27	18.0	81.3
	56.000-57.999	7	5.2	86.7	9	7.2	81.6	10	6.7	88.0
	58.000-59.999	3	2.2	88.9	8	6.4	88.0	6	4.0	92.0
	60.000-61.999	5	3.7	92.6	4	3.2	91.2	6	4.0	96.0
	62.000-63.999	6	4.4	97.0	2	1.6	92.8	1	.7	96.7
	64.000-65.999	1	.7	97.8	3	2.4	95.2	4	2.7	99.3
	66.000-67.999	1	.7	98.5	1	.8	96.0	1	.7	100.0
	68.000-69.999	..	...	98.5	1	.8	96.8	..	...	...
	70.000-71.999	1	.7	99.3	..	...	96.8	..	...	...
	72.000-73.999	1	.7	100.0	2	1.6	98.4	..	...	...
	74.000-75.999	..	...	...	2	1.6	100.0	..	...	...
	Total	135	99.8		125	100.0		150	100.1	

STATISTICAL CONSTANTS				
Absolute	$M \pm P.E.$	50.509 ± 0.408	50.905 ± 0.490	51.706 ± 0.323
	$\sigma \pm P.E.$	7.050 ± 0.289	8.125 ± 0.346	5.860 ± 0.229
	$V \pm P.E.$	13.95 ± 0.57	15.95 ± 0.680	11.34 ± 0.442
Relative	$M \pm P.E.$	138.02 ± 1.021	145.70 ± 1.285	156.55 ± 1.035
	$\sigma \pm P.E.$	17.60 ± 0.72	21.30 ± 0.90	18.80 ± 0.73
	$V \pm P.E.$	12.74 ± 0.52	14.62 ± 0.62	12.02 ± 0.47
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN	U.S.-JAPAN-JAPAN	JAPAN-U.S.A.
Absolute	$M \pm P.E.$	+ 0.396 ± 0.639	+ 0.801 ± 0.585	— 1.197 ± 0.521
	$\sigma \pm P.E.$	+ 1.075 ± 0.451	— 2.265 ± 0.415	+ 1.190 ± 0.368
	$V \pm P.E.$	+ 2.00 ± 0.88	— 4.61 ± 0.81	+ 2.61 ± 0.72
Relative	$M \pm P.E.$	+ 7.68 ± 1.04	+10.85 ± 1.65	—18.53 ± 1.45
	$\sigma \pm P.E.$	+ 3.70 ± 1.15	— 2.50 ± 1.07	— 1.20 ± 1.03
	$V \pm P.E.$	+ 1.88 ± 0.77	— 2.60 ± 0.78	+ 0.72 ± 0.77

Comparable data for American white women are shown in Table 30, in which it appears that they weigh decidedly heavier, on the average, than Japanese women of corresponding stature and age.

SUMMARY

Anthropometrical measurements and comparative biometrical studies were made on four different groups of matured (18 to 30 years) Japanese women who were born and reared in the different environment of Japan and of the United States. The mean stature of the group of Japanese women who were born and reared in Japan proper (Group Japan) is 1497.8 mm. with the standard deviation 45.2 mm., while in the group of Japanese women who were born and reared in the United States (Group U.S.A.) it is 1540.0 mm. with the standard deviation 50.0 mm., which makes a difference of 42.2 mm. in favor of the latter The mean stature of the group of Japanese women who were born in the United States, but reared in Japan from infancy and childhood (average age from 3 years 8 months to 17 years 10 months) then returned to the United States and lived here up to the present time (Group U.S.-Japan), is 1519.3 mm. with the standard deviation 54.9 mm. It is exceeded by Group U.S.A. by 20.7 mm. but is 21.5 mm. higher than that of Group Japan. The average stature of the limited number group of Japanese women who were born in Japan, but reared in the United States from infancy and childhood (average age, 4 years 1 month: Group Japan-U.S.) is 1539.7 mm., which is practically the same as that of Group U.S.A. These facts are strong evidences that the increased stature of American-born Japanese women is chiefly due to the effect of the more favorable influence of the new environment and is not simply a phenomenon of selection, as has been thought by many.

This marked increase in stature of Group U.S.A. is 3.1 times that of new-born Japanese infants in the United States. This rate of growth from birth to maturity is identically the same as that of Japanese women in Japan proper, indicating that the proper rate for Japanese race growth is unchanged in the new environment. But Group U.S.-Japan has failed to attain its normal rate of growth from birth to maturity and furnishes another evidence that the environment in Japan is less favorable for optimum growth for Japanese than is that of the United States.

TABLE 30

Average weight of various groups of American white women with stature and occupation, within limited age

INVESTIGATOR	DATE	MATERIAL	CASE NO.	AGE (*year*)	BODY WEIGHT			ROHRER'S* INDEX	STATURE (*mm.*)
					$M \pm P.E.$ (*kg.*)	σ (*kg.*)	V		
Jackson, G. M.	1929	Univ. Minnesota students	1022	19.56	54.37 ± 0.17	7.99	14.70	128.6	1616.9
Steggerda *et al.*	1929	Smith College students	100	20.15	55.59 ± 0.8161	12.1	21.77	128.9	1628.1
Hooton, E. H.	1931	All occupations	1075	20-34	56.20	7.85	14.0	131.2	1623.9
Bayer and Gray	1934	Working women	100	36.2	61.48 ± 0.49	7.27	11.82	145.8	1615.5
Hrdlička, A.	1925	Old Americans	71	22-29	55.97	...	....	130.2	162.6 cm.

* The writer is responsible for the calculation of Rohrer's index from the stature and weight for the respective groups.

In sitting-height, Group U.S.A. is highest in the absolute and lowest in the relative measurements among the three groups; Group Japan is lowest in the absolute and highest in the relative measurements; Group U.S.-Japan, medium both in the absolute and the relative measurements. The differences in the relative measurements among the groups, however, are not large enough to be considered of any significance. The average for the limited number group, Group Japan-U.S. is slightly higher than that of Group U.S.A. in both absolute and relative measurements. All these facts indicate that the racial characteristic of higher sitting-height of Japanese people is unchanged in the new environment.

In the measurements of the lower extremities (height of trochanter) it is shown that Group U.S.A. is highest in both the absolute and the relative measurements, Group Japan the lowest, while Group U.S.-Japan is between the two. The differences in the relative measurements between each group, however, are so slight that they are not statistically significant as in the case of the sitting-height. The average for Group Japan-U.S. is lower in the absolute and smaller in the relative measurements than in any other group in the study, contrary to the results obtained from the measurements of sitting-height in the previous study.

Thus, from the linear or longitudinal body measurements, namely, stature, sitting-height, and height of trochanter, of the various groups of Japanese women in this study, it is shown that the racial characteristic bodily-proportion of Japanese women—relatively higher trunk and shorter lower extremities—has not been affected by the changed growth rate in stature under a different environment.

In the lateral development of the body, the results obtained from the measurements, such as span, bi-acromial and bi-cristal diameters, in the groups of Japanese women who were born and reared in the United States, except Group Japan-U.S., are found to be more favorable than are those of Japanese women in Japan proper. In thoracic circumference the American-influenced groups, especially Group U.S.A., are found to be less favored than are the Japanese women in Japan proper. This phenomenon, in explanation it may be said, is probably due to the effect of sudden and unusually marked increase in growth of stature of Group U.S.A. and Group Japan-U.S., and it is compensatory and transient in nature. The lack of sufficient breast secretion of the average Nisei women has been thought to be connected with this poor thoracic development.

Circumference of head in Group Japan and in Group U.S.A. is almost identically the same, while in Group U.S.-Japan and in Group Japan-U.S. it is slightly smaller. This would indicate that head circumference is rather stable, and unaffected by different environments during the course of growth.

In body weight, the results obtained are very similar to those found in thoracic circumference, namely, Group Japan is heaviest in body weight and greatest in Rohrer's index; Group U.S.A., lightest in body weight and smallest in Rohrer's index; Group U.S.-Japan is between these two groups. Group Japan-U.S. is lighter in average weight and smaller in Rohrer's index than the other groups in this study. It is my contention that this phenomenon, as in the case of the thoracic circumference, is compensatory and transient in character and is due to the sudden and greatly increased growth in stature, which has often been observed in the course of growth in mankind in general.

As has been discussed previously, the measurements in the limited number group of Japanese women, who were born in Japan but reared in the United States from childhood—Group Japan-U.S.—equal the

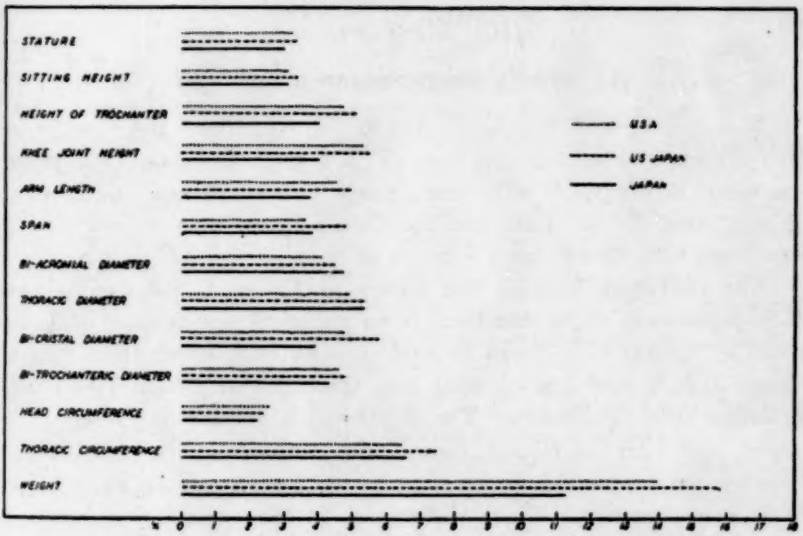


FIG. 2. COMPARISONS BETWEEN VARIABILITIES OF BODY MEASUREMENTS OF JAPANESE WOMEN IN DIFFERENT ENVIRONMENT

average stature of the group of Japanese women who were born and reared in the United States—Group U.S.A. The racial characteristic longitudinal body proportion—high trunk with shorter lower extremities —has not changed, but the lateral developments are generally found to be less favorable than among the other groups in this study. This indicates that the birth and the period of infancy and childhood are more important than the later age period for growth and the building up of the human body.

A comparison of the dispersions, or coefficient of variation, of the groups shows that the group of women who had changed their environment during the course of growth (Group U.S.-Japan) had the greatest variability for all the measurements (except those of biacromial diameter and head circumference), while those of the group which consisted of rather homogeneous individuals, socially and economically (Group Japan), were shown to have the least variability (Fig. 2).

In comparison with other races, the body type of Japanese women in any group in this study is not like that of any of the other races in the United States, except for a few existing similarities with American Indian women on the Pacific Coast.

III. Blood pressure

A. Systolic blood pressure (Table 31)

Mean of Group U.S.A., is 115.82 ± 0.57 mm. Hg.; range = 96-150 mm., $\sigma = 9.85 \pm 0.40$ mm. ($V = 8.52$). In Group U.S.-Japan, the mean is 113.74 ± 0.64 mm.; range = 94-148 mm., $\sigma = 10.45 \pm 0.45$ mm. ($V = 9.20$) and for Group Japan it is 116.66 ± 0.69 mm.; range = 89-146 mm., $\sigma = 10.52 \pm 0.41$ mm. ($V = 9.03$).

The difference between the means of Group U.S.A. and Group U.S.-Japan is so slight that there is no statistical significance, while the mean of Group U.S.-Japan is 2.08 ± 0.85 mm. lower than that of Group U.S.A. and 2.92 ± 0.94 mm. than that of Group Japan with probably little significance. The dispersion is greatest in Group U.S.-Japan and least in Group Japan, with Group U.S.A. the medium between the two, which is the same as has been found in most of the body measurements. These differences in the variabilities, however, are too slight to be of any statistical significance. The average systolic blood pressure of Group Japan-U.S. is 114.9 mm., ranging from 106

to 124 mm., which is the medium between Group U.S.A. and Group U.S.-Japan.

The normal value of blood pressure level is definitely influenced by age, sex, and body build. It is also modified even in the same

TABLE 31

Systolic blood pressures: Showing range, frequency distributions, statistical constants and differences between each group of the Japanese women in different environments

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm. Hg.*)		96-150			94-148			89-146		
FREQUENCY DISTRIBUTION	Classes grouped in 4mm. Hg.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	88.0- 91.9	..	...	...	..	...	...	1	.7	.7
	92.0- 95.9	..	...	...	2	1.6	1.6	4	2.7	3.3
	96.0- 99.9	2	1.5	1.5	4	3.2	4.8	1	.7	4.0
	100.0-103.9	8	5.9	7.4	12	9.6	14.4	5	3.3	7.3
	104.0-107.9	15	11.1	18.5	15	12.0	26.4	13	8.7	16.0
	108.0-111.9	22	16.3	34.8	27	21.6	48.0	23	15.3	31.3
	112.0-115.9	23	17.0	51.8	10	8.0	56.0	22	14.7	46.0
	116.0-119.9	20	14.8	66.7	18	14.4	70.4	19	12.7	58.7
	120.0-123.9	18	13.3	80.0	18	14.4	84.8	24	16.0	74.7
	124.0-127.9	9	6.7	86.7	7	5.6	90.4	14	9.3	84.0
	128.0-131.9	10	7.4	94.1	4	3.2	93.6	8	5.3	89.3
	132.0-135.9	2	1.5	95.6	4	3.2	96.8	11	7.3	96.7
	136.0-139.9	4	3.0	98.6	1	.8	97.6	2	1.3	98.0
	140.0-143.9	..	...	98.6	1	.8	98.4	2	1.3	99.3
	144.0-147.9	1	.7	99.3	1	.8	99.2	1	.7	100.0
	148.0-151.9	1	.7	100.0	1	.8	100.0	..	...	...
	Total	135	99.9		125	100.0		150	100.0	

STATISTICAL CONSTANTS			
$M \pm P.E.$	115.82 ± 0.57	113.74 ± 0.64	116.66 ± 0.69
$\sigma \pm P.E.$	9.85 ± 0.40	10.45 ± 0.45	10.52 ± 0.41
$V \pm P.E.$	8.52 ± 0.35	9.20 ± 0.39	9.03 ± 0.34
DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN	U.S.-JAPAN-JAPAN	JAPAN-U.S.A.
$M \pm P.E.$	-2.08 ± 0.853	$+2.92 \pm 0.939$	-0.84 ± 0.886
$\sigma \pm P.E.$	$+0.60 \pm 0.58$	$+0.07 \pm 0.61$	-0.67 ± 0.57
$V \pm P.E.$	$+0.68 \pm 0.53$	-0.17 ± 0.52	-0.51 ± 0.49

individual by different observers (posture of the subject, criteria, method employed and instruments used, etc.). For this reason, it is not justifiable to compare our results with others without considering the conditions just mentioned. However, the following tabulation (Table 32) was made, hoping to give some idea of the systolic pressure of white women in the United States. It is interesting to note that the mean and coefficient of variation of the average systolic pressure which both Jackson (29) and Alvarez (44) give are nearly the same as those of the Japanese groups. Symond's (45) results from the insurance-entrants were as high as 122-3 mm., while Burlage's (46) students were as low as 110 mm., and Walser's (47) normal pregnant women were still lower, 108 mm. Recently Robinson (48), after observing the blood pressure of 11,383 persons, states that "the normal range of systolic blood pressure for men and women is from 90 to 120 mm."

Summarizing the above study, the average systolic blood pressure of various groups of Japanese women who were born and reared in different environment do not show any significant differences between each group. Comparison with other races in the United States is not satisfactory as there is a wide range of difference in the average systolic pressure as presented by different authors and there is lack of uniformity of methods and criteria employed in taking the blood pressure.

B. Diastolic blood pressure (Table 33)

Mean of Group U.S.A. is 68.85 ± 0.59 mm. Hg.; range = 40-98 mm., σ = 9.11 ± 0.39 mm. (V = 13.95). In Group U.S.-Japan it is 66.79 ± 0.62 mm.; range = 34-96 mm., σ = 10.37 ± 0.42 mm. (V = 15.50). For Group Japan it is 68.66 ± 0.57 mm.; range = 41-96 mm., σ = 10.18 ± 0.40 mm. (V = 14.42).

There is no significant statistical difference between the means of Group U.S.A. and Group Japan, while the mean of Group U.S.-Japan is 2.06 ± 0.86 smaller than that of Group U.S.A. and 1.87 ± 0.845 than that of Group Japan, which is probably of no importance. Dispersion is greatest in Group U.S.-Japan as usual and least in Group U.S.A., and Group Japan is between the two.

TABLE 32

Systolic blood pressure of American white women by different investigators

INVESTIGATOR	YEAR PUBLISHED	POSITION	METHOD	INSTRUMENT	SUBJECTS	AGE	NO.	$M \pm P.E.$ (*mm.*)	σ (*mm.*)	V
Alvarez	1923	Standing	Palpatory	Mercury	Students	23	387	116.4 ± 0.38	11.1	9.5
Alvarez	1923	Standing	Palpatory	Mercury	Students	16-40	8934	117.3 ± 0.08	10.8	9.2
Burlage	1922	Sitting	Auscultatory	Mercury	Students	18-26	800	110.0	....	...
Symonds	1923	Sitting	Palpat. and Auscult.	Tycos	Ins. ent.	15-30	11937	122 — 123mm.	....	...
Jackson	1929	Reclining	Auscultatory	Mercury	Students	15-47	933	116.98 ± 0.23	10.55	9.02
Walser	1930	Lying down	Auscultatory	Mercury	Normal pregnant women	21-25	234	107.0	....	...
Walser	1930	Lying down	Auscultatory	Mercury	Normal pregnant women	26-30	400	109.0	....	...

The relation of diastolic pressure to the systolic pressure in the three groups is nearly the same, as is shown in the following:

Group U.S.A. = D.P. : S.P. :: 59.45 : 100
Group U.S.-Japan = D.P. : S.P. :: 58.72 : 100
Group Japan = D.P. : S.P. :: 58.85 : 100

The average diastolic pressure of the limited number group, Group Japan-U.S. is 71.4 mm. with a range of 66 to 76 mm. The relation to the systolic pressure is D.P. : S.P. :: 62.13 : 100, which is the highest of all the groups in the study.

Symonds (45) gives 79.5 to 80.5 mm. for the average diastolic pressure for the corresponding age group of American white women (insurance entrants). Burlage's (46) average for the University of California students was about 74 mm. and the average for normal pregnant women by Walser (47) was 64 mm. for the 26 to 30-years age group and 64 mm. for the 20 to 30-years age group. The recent study on 11,383 persons by Robinson (48) was 60 to 80 mm. for normal range of men and women. Most of these figures are somewhat higher than those for the Japanese groups.

Summarizing the above accounts, it may be concluded that the diastolic pressure of the different groups of Japanese women who were born and reared in different environments is practically the same and it appears to be slightly lower than that of American white women for the corresponding age group.

C. Pulse blood pressure (Table 34. Fig 3)

Mean of Group U.S.A. is 47.87 ± 0.37 mm. Hg.; range = 25-74 mm., $\sigma = 6.45 \pm 0.26$ mm. ($V = 13.25$). In Group U.S.-Japan it is 47.70 ± 0.54 mm.; range = 25-74 mm., $\sigma = 8.88 \pm 0.38$ mm. ($V = 18.60$). For Group Japan it is 48.72 ± 0.48 mm.; range = 30-84 mm., $\sigma = 8.80 \pm 0.34$ mm. ($V = 18.10$).

There is no significant statistical difference between the means of each group. The dispersion is the greatest in Group U.S.-Japan as usual, but the difference from that of Group Japan is of no statistical significance. That of Group U.S.A. is the lowest and is 5.4 lower than that of Group U.S.-Japan and 4.9 than that of Group Japan.

The relation of the average pulse pressure to systolic pressure for each group is nearly the same, namely:

Group U.S.A. = P.P. : S.P. :: 41.33 : 100
Group U.S.-Japan = P.P. : S.P. :: 41.94 : 100
Group Japan = P.P. : S.P. :: 41.76 : 100

The average pulse pressure for the limited number group, Group Japan-U.S., is 43.4 mm. with a range of 34 to 52 mm. In relation to systolic pressure it is 37.76, which is the lowest in the entire group.

In comparison with American white women, Symond's (45) average pulse pressure for the insurance entrants (20-24 years age group) was

TABLE 33

Diastolic blood pressures: Showing range, frequency distributions, statistical constants and differences between each group of Japanese women in different environments

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm. Hg.*)		40-98			34-96			41-96		
FREQUENCY DISTRIBUTION	Classes grouped in 4mm. Hg.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	34.0- 37.9	..	...	...	1	0.8	0.8	..	...	...
	38.0- 41.9	1	0.7	0.7	..	...	0.8	1	0.7	0.7
	42.0- 45.9	..	...	0.7	1	0.8	1.6	..	...	0.7
	46.0- 49.9	2	1.5	2.2	1	0.8	2.4	1	0.7	1.3
	50.0- 53.9	2	1.5	3.7	4	3.2	5.6	4	2.6	4.0
	54.0- 57.9	9	6.7	10.4	10	8.0	13.6	18	12.0	16.0
	58.0- 61.9	14	10.4	20.7	21	16.8	30.4	16	10.7	26.7
	62.0- 65.9	19	14.1	34.8	17	13.6	44.0	16	10.7	37.4
	66.0- 69.9	26	19.3	54.1	22	17.6	61.6	24	16.0	53.4
	70.0- 73.9	18	13.3	67.4	15	12.0	73.6	16	10.7	64.1
	74.0- 77.9	20	14.8	82.2	13	10.4	84.0	17	11.3	75.4
	78.0- 81.9	11	8.2	90.4	10	8.0	92.0	19	12.7	88.0
	82.0- 85.9	8	5.9	96.3	5	4.0	96.0	10	6.6	94.7
	86.0- 89.9	1	0.7	97.0	3	2.4	98.4	7	4.7	99.4
	90.0- 93.9	1	0.7	97.8	1	0.8	99.2	..	...	99.4
	94.0- 97.9	2	1.5	99.3	1	0.8	100.0	1	0.7	100.1
	98.0-101.9	1	0.7	100.0	..	...	...	..	...	...
	Total	135	100.0		125	100.0		150	100.1	
STATISTICAL CONSTANTS	$M \pm P.E.$		68.85 ± 0.59			66.79 ± 0.62			68.66 ± 0.57	
	$\sigma \pm P.E.$		9.11 ± 0.39			10.37 ± 0.42			10.18 ± 0.40	
	$V \pm P.E.$		13.95 ± 0.57			15.50 ± 0.66			14.42 ± 0.58	
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
	$M \pm P.E.$		−2.06 ± 0.856			+ 1.87 ± 0.845			+ 0.19 ± 0.820	
	$\sigma \pm P.E.$		+ 1.26 ± 0.57			− 0.19 ± 0.57			− 0.07 ± 0.55	
	$V \pm P.E.$		+ 1.55 ± 0.87			− 1.08 ± 0.86			− 0.47 ± 0.81	

43.7 mm. Burlage's (46) average for college women (Univ. of Calf.: 20-26 years age group) was from 33.17 to 38.95 mm. Walser's (47) average for normal pregnant women was 36 mm. for the age group of 21-25 years and 45 mm. for the 26-30 years group. Robinson's

TABLE 34

Pulse blood pressures: Showing range, frequency distributions, statistical constants and differences between each group of Japanese women in different environments

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*mm. Hg.*)		25-74			25-74			30-84		
FREQUENCY DISTRIBUTION	Classes grouped in 4mm. Hg.	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	24.0-27.9	..	...	...	1	0.8	0.8	..	...	...
	28.0-31.9	7	5.2	5.2	5	4.0	4.8	..	...	...
	32.0-35.9	8	5.9	11.1	7	5.6	10.4	5	3.3	3.3
	36.0-39.9	14	10.4	21.5	7	5.6	16.0	17	11.3	14.6
	40.0-43.9	12	8.9	30.4	21	16.8	32.8	31	20.7	35.3
	44.0-47.9	28	20.7	51.1	23	18.4	51.2	24	16.0	51.3
	48.0-51.9	27	20.0	71.1	30	24.0	75.2	20	13.3	64.6
	52.0-55.9	16	11.9	83.0	13	10.4	85.6	27	18.0	82.6
	56.0-59.9	6	4.4	87.4	3	2.4	88.0	12	8.0	90.6
	60.0-63.9	11	8.1	95.5	6	4.8	92.8	7	4.7	95.3
	64.0-67.9	4	3.0	98.5	8	6.4	99.2	3	2.0	97.3
	68.0-71.9	..	...	98.5	..	...	99.2	1	0.7	98.0
	72.0-75.9	2	1.5	100.0	1	0.8	100.0	2	1.3	99.3
	76.0-79.9	..	...	...	..	...	...	..	...	99.3
	80.0-83.9	..	...	...	..	...	...	1	0.7	100.0
	Total	135	100.0		125	100.0		150	100.0	
STATISTICAL CONSTANTS	$M \pm P.E.$		47.87 ± 0.37			47.70 ± 0.54			48.72 ± 0.48	
	$\sigma \pm P.E.$		6.45 ± 0.26			8.80 ± 0.38			8.80 ± 0.34	
	$V \pm P.E.$		13.25 ± 0.54			18.60 ± 0.78			18.10 ± 0.70	
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
	$M \pm P.E.$		−0.17 ± 0.65			+1.02 ± 0.72			−0.85 ± 0.61	
	$\sigma \pm P.E.$		+2.43 ± 0.14			−0.08 ± 0.51			−2.35 ± 0.43	
	$V \pm P.E.$		+5.35 ± 1.95			−0.50 ± 1.05			+4.85 ± 0.88	

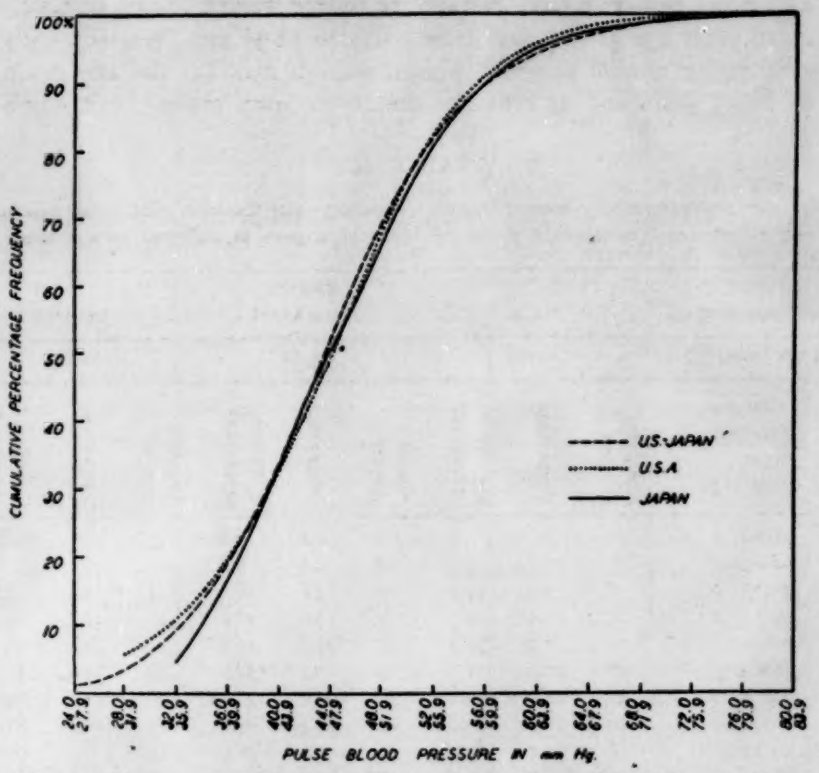


FIG. 3. CUMULATIVE PERCENTAGE FREQUENCY OF PULSE BLOOD PRESSURE OF JAPANESE WOMEN IN DIFFERENT ENVIRONMENTS

(48) average normal range was 30-40 mm. It is apparent that American white women have, on the average, a lower pulse pressure than have the Japanese women.

Summarizing the above facts, the average pulse blood pressure of Japanese was found unaffected by the change of somatic growth in the different environment.

SUMMARY

The systolic, diastolic, and pulse blood pressure of various groups of Japanese women who were born and reared in different environments are compared. Mean systolic pressure of Group U.S.A. (115.82 mm.) is nearly the same as Group Japan (116.66 mm.) while that of Group U.S.-Japan (113.74 mm.) is a few millimeters (2-3 mm.) lower than

either of these groups. The dispersion is the greatest in Group U.S.-Japan as usual, that of Group U.S.A. is the least, and that of Group Japan is between the two. The difference between each group, however, is so slight that it is of no statistical significance.

Mean diastolic blood pressure is almost identically the same for Group U.S.A. (68.85 mm.) and Group Japan (68.66 mm.) while that of Group U.S.-Japan (66.8 mm.) is about 2 mm. lower as in the case of systolic pressure. It is probably not important. The relation of the diastolic pressure to the systolic pressure in the groups is very close, namely, it is 59.45 for Group U.S.A., 58.72 for Group U.S.-Japan, and 58.85 for Group Japan. The dispersion is greatest in Group U.S.-Japan and least in Group U.S.A., and Group Japan is between the two. But the difference between each group is so slight that it is statistically insignificant, as was found in the systolic pressure.

In pulse pressure, the means of Group U.S.A. (47.87 mm.) and of Group U.S.-Japan (47.70 mm.) are almost the same, while the mean of group Japan (48.72 mm.) is about 1 mm. higher than for the other groups. The relation of the average pulse pressure to the systolic is approximately the same among the groups, namely, it is 41.33 for Group U.S.A., 41.94 for Group U.S.-Japan, and 14.76 for Group Japan. The dispersion is greatest in Group U.S.-Japan, which is 5.35 greater than that of Group Japan, while the difference from Group Japan is of no statistical significance.

The average systolic pressure of Group Japan-U.S. (114.9 mm.) is found to be approximately the same as in the other groups, but the diastolic (71.4 mm.) is so much higher that the pulse pressure (43.4 mm.) is the lowest among the groups. The relation of the diastolic to systolic pressure (62.13) is the highest while that of the pulse to systolic pressure (37.76) is the lowest in all the groups.

Comparison with American white women is not satisfactory but from the available data it appears that the average systolic pressure of American white women is slightly higher than it is in the Japanese groups. But their average diastolic pressure is so high that it results in a pulse pressure that is appreciably lower than that of the Japanese women.

From the above facts it may be concluded that the blood pressure of Japanese women is little affected by the new environment in which certain somatic growth change has taken place.

IV. Menarcheal age (Table 35. Fig. 4)

Mean of Group U.S.A. is 13.093 ± 0.066 or 13 yrs. 1 mo. 4 days; range = 10-18 yrs., σ = 1.112 or 13 mos. 11 days (V = 8.80). In Group U.S.-Japan it is 14.827 ± 0.068 or 14 yrs. 10 mos. 2 days; range = 13-18 years, σ = 1.162 or 13 mos. 2 days (V = 8.24). For Group Japan it is 14.781 ± 0.066 or 14 yrs. 9 mos. 11 days; range = 12.4-18.8 yrs., σ = 1.197 or 14 mos. 12 days (V = 8.4).

Mean of Group Japan and of Group U.S.-Japan is practically the same and it is about 1.7 higher, or 1 year 8.4 months later, than that

TABLE 35

Menarcheal age: Showing range, frequency distribution, statistical constants and difference between each group in different environments

MEASUREMENTS		GROUPS U.S.A.			U.S.-JAPAN			JAPAN		
RANGE (*Year*)		10-18			13-18			12.42-18.83		
FREQUENCY DISTRIBUTION	Classes grouped in year	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage	Absolute number	Percentage	Cumulated percentage
	9.5-10.5	1	.7	.7	..	...	...	..	...	...
	10.5-11.5	3	2.2	2.9	..	...	...	..	...	...
	11.5-12.5	38	28.2	31.1	..	...	...	1	.7	.7
	12.5-13.5	50	37.0	68.1	15	12.0	12.0	16	10.7	11.3
	13.5-14.5	34	25.2	93.3	37	29.6	41.6	46	30.7	42.0
	14.5-15.5	5	3.7	97.0	37	29.6	71.2	49	32.7	74.7
	15.5-16.5	1	.7	97.7	27	21.6	92.8	26	17.3	92.0
	16.5-17.5	2	1.5	99.3	7	5.6	98.4	11	7.3	99.3
	17.5-18.5	1	.7	100.0	2	1.6	100.0	1	.7	100.0
	Total	135	99.9		125	100.0		150	100.1	
STATISTICAL CONSTANTS	$M \pm P.E.$	13.093 ± 0.066			14.827 ± 0.068			14.781 ± 0.066		
	$\sigma \pm P.E.$	1.112 ± 0.047			1.162 ± 0.049			1.197 ± 0.047		
	$V \pm P.E.$	8.80 ± 0.36			8.24 ± 0.56			8.40 ± 0.33		
	DIFFERENCE BETWEEN	U.S.A.-U.S.-JAPAN			U.S.-JAPAN-JAPAN			JAPAN-U.S.A.		
	$M \pm P.E.$	+ 1.734 ± 0.096			− 0.046 ± 0.096			− 1.715 ± 0.093		
	$\sigma \pm P.E.$	+ 0.050 ± 0.068			+ 0.035 ± 0.068			− 0.085 ± 0.066		
	$V \pm P.E.$	− 0.56 ± 0.66			+ 0.16 ± 0.64			+ 0.40 ± 0.48		

of Group U.S.A. The differences in the dispersions are so slight that they are not of statistical significance. The average menarcheal age of the limited number group, Group Japan-U.S. is 12 years 10 months, ranging from 11 years 7 months to 14 years 1 month, being 3 months earlier than that of Group U.S.A. and almost 2 years earlier than Group Japan and Group U.S.-Japan. It appears that the

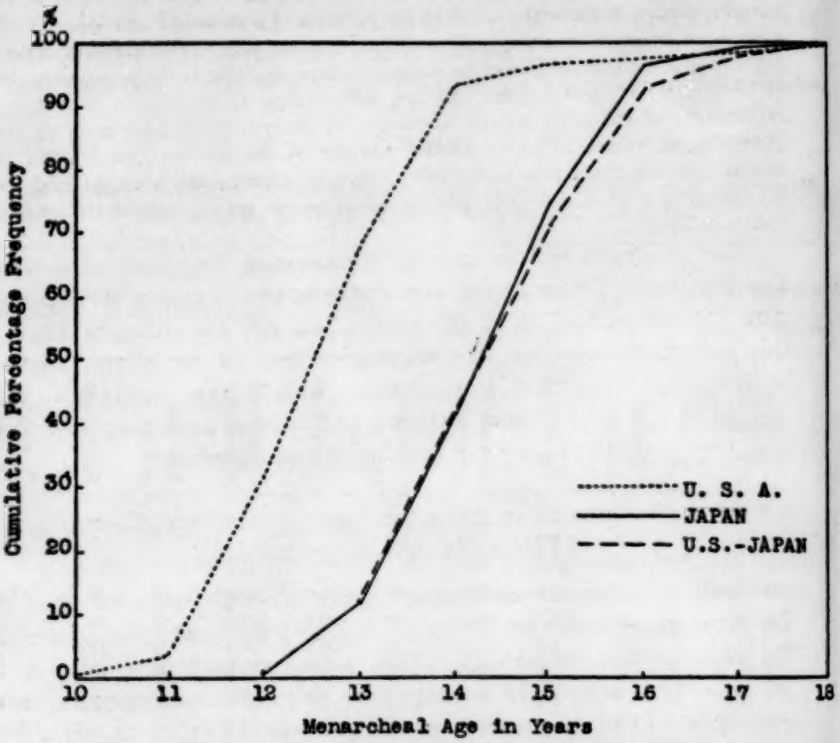


FIG. 4. CUMULATIVE PERCENTAGE FREQUENCY OF MENARCHEAL AGE OF JAPANESE WOMEN IN DIFFERENT ENVIRONMENTS

Japanese women who were reared in the United States, whether they were born in Japan or in the United States, start to menstruate almost 2 years earlier than those who were reared in Japan whether they were born in Japan or in the United States, showing that the age of onset of catamenia is decidedly influenced by the nature of the environment in which the groups had been reared, rather than by the effect of the environment at birth or during infancy or childhood.

Literature concerning the age of onset of first menstruation is abundant in Japan, in Europe and America with the resultant accumulation of data thereon. Fluhmann (49) states,

> Since the days when Brierre de Boismont first made a statistical study of the age of onset of menstruation and computed an average figure, this problem seems to have possessed a peculiar fascination for a large army of clinical investigators. The literature abounds with scores of studies, many based upon thousands of subjects, but most unfortunately valueless for purposes of comparison and open to doubts as to their scientific accuracy. This is due in great part to the different ways of expressing age classes employed by various authors, and also to the prevalent method of obtaining the ages of the subjects, which depends usually on the doubtful recollection of the adult patient questioned by inexperienced assistances in large gynecological clinics. Only a limited number of women can cite the day and month. In recent years, however, more exact information has been obtained from the observation of school girls, but the series are as yet not sufficiently large for final conclusions.

This statement will be accepted by the most conscientious workers. For this reason I have undertaken investigations to obtain the necessary data for comparison as to the menarcheal age for different races in this part of the country. To accomplish this, all the women students at the City College of Los Angeles, with a few exceptions, were investigated with the same methods and criteria previously described. The results obtained are very interesting and significant.

Racial differences in menarcheal age in Southern California (Tables 36, 37, 38, 39 and 40)

Table 36 shows that the average age of onset of menstruation of the Japanese students is 13.1, or 13 yrs. 1 mo. 7 days, which is identically the same as that for Group U.S.A. whose average is 13.093, or 13 yrs. 1 mo. 4 days. The average for Negro students appears to be very close to that of Japanese women, namely, 13.11, or 13 yrs. 1 mo. 11 days. Mexican girls start to menstruate earlier than any other race in the study, at 12.55, or 12 yrs. 6 mos. 21 days. This is about 6 months earlier than for Japanese and Negro girls. For white women students the average is 12.9, or 12 yrs. 11 mos., which is about 2 months earlier than for Negro or Japanese women, and about 4 months later than for Mexicans. Chinese women start to menstruate later than any other racial group—13.94, or 13 yrs. 11 mos. 15 days. This is about 10 months later than the average for Japanese or Negro women, a little over one year later than the average for white girls, and about one and one-half years later than Mexicans.

TABLE 36

Frequency distributions and average menarcheal ages of the Los Angeles City College women by races

AGE GROUPS (*Year*) (Nearest age)	ALL RACES			WHITE			JAPANESE			NEGRO			MEXICAN			CHINESE		
	Number	Percentage	Cumulated percentage	Number	Percentage	Cumulated percentage	Number	Percentage	Cumulated percentage	Number	Percentage	Cumulated percentage	Number	Percentage	Cumulated percentage	Number	Percentage	Cumulated percentage
7.5- 8.5	1	.04	.04	1	.05	.05	..	....	....	..	....	....	..	....	....	..	....	....
8.5- 9.5	2	.08	.12	2	.09	.14	..	....	....	..	....	....	..	....	....	..	....	....
9.5-10.5	25	.98	1.10	23	1.08	1.22	1	.58	.58	1	.61	.61	..	....	....	..	....	....
10.5-11.5	225	8.84	9.94	201	9.40	10.62	7	4.05	4.62	12	7.27	7.88	5	9.62	9.62	..	....	....
11.5-12.5	727	28.56	38.51	615	28.77	39.38	40	23.12	27.75	44	26.67	34.55	26	50.00	59.62	2	11.76	11.76
12.5-13.5	840	33.01	71.51	707	33.07	72.45	66	38.15	65.90	50	30.30	64.85	12	23.08	82.69	5	29.41	41.18
13.5-14.5	465	18.27	89.78	377	17.63	90.08	44	25.43	91.33	32	19.39	84.24	6	11.54	94.23	6	35.29	76.47
14.5-15.5	181	7.11	96.90	142	6.64	96.73	14	8.09	99.42	21	12.73	96.97	2	3.85	98.08	2	11.76	88.24
15.5-16.5	67	2.63	99.53	61	2.85	99.58	1	.58	100.00	4	2.42	99.39	1	1.92	100.00	..	....	88.24
16.5-17.5	9	.35	99.88	6	.28	99.86	..	....	....	1	.61	100.00	..	....	....	2	11.76	100.00
17.5-18.5	1	.04	99.92	1	.05	99.91	..	....	....	..	....	....	..	....	....	..	....	....
18.5-19.5	1	.04	99.96	1	.05	99.95	..	....	....	..	....	....	..	....	....	..	....	....
19.5-20.5	1	.04	100.00	1	.05	100.00	..	....	....	..	....	....	..	....	....	..	....	....
Total	2545	99.99		2138	100.01		173	100.00		165	100.00		52	100.01		17	99.98	
Average	12.94 (12y. 11m. 15d.)			12.90 (12y. 10m. 28d.)			13.10 (13y. 1m. 7d.)			13.11 (13y. 1m. 11d.)			12.55 (12y. 6m. 21d.)			13.94 (13y. 11m. 15d.)		

TABLE 37

Recent average menarcheal age of Japanese women (by occupation) in Japan-General and in certain localities from which came most of the immigrants to the U.S.A.

INVESTIGATORS	LOCALITY	DATE	NUMBER	OCCUPATION	AVERAGE MENARCHEAL AGE
Okatani-Teruuchi	Japan-General	....	20,883	General	14 yrs. 6.72 mos.
Ishizuka	Japan-General	1934	6,354	General	14 yrs. 3.7 mos.
Central Review	Japan-General	1934	6,354	General	14 yrs. 3 mos.
Yoshioka	Japan-General	1936	1,172	General	14 yrs. 2.7 mos.
Matsuyama	Japan-General	1929	3,475	Student	14 yrs. 2 mos.
Tsuji	Japan-General	1930	10,600	Student	14 yrs. 3.23 mos.
Kobata	Tokyo	1929	1,532	Student	14 yrs. 2½ mos.
Central Review	Kinki	1934	1,792	General	14 yrs. 1 mo.
Matsuyama	Kinki	1929	692	Student	14 yrs. 4 mos.
Otsuka-Hioka	Hiroshima	1907	1,493	General	14 yrs. 11 mos.
Central Review	Chiugoku	1934	568	General	14 yrs. 5 mos.
Shintani	Chiugoku	1928	417	General	15 yrs. 3 mos.
Tsuji	Chiugoku	1930	506	Student	14 yrs. 4 mos.
Matsuyama	Chiugoku	1929	334	Student	14 yrs. 2 mos.
Central Review	Kyushu	1934	941	General	14 yrs. 5 mos.
Ogata, E.	Kagoshima	1929	1,000	General	15 yrs. 6 mos.
Tsuji	Kyushu	1930	4,670	Student	14 yrs. 2 mos.
Tsuji	Kumamoto	1930	10,600	Student	14 yrs. 3 mos.

This table was prepared by selections from the data appearing in Dr. S. Fukui's Monograph on Menstruation (70), Sairen Co., *Tokio, Japan,* 1936.

If a comparison is made between the average menarcheal age of each race at the City College of Los Angeles and that of the corresponding group of the respective race elsewhere (Tables 37, 38, 39, 40), it will be found that the girls here appear to start menstruating more or less earlier than those of the respective groups of races elsewhere (according to their proper racial menarcheal age thereof). For instance, Japanese women here start to menstruate about one and one-half years earlier than Japanese women students in Japan proper; white girls, a few months earlier than most groups of white girls in other parts of the country; Negro girls about six months earlier than those of the Eastern States; Chinese girls about one year or more earlier than those in China. For Mexican girls, the author failed to obtain comparative data. In short, the average age at menarche of woman students at

TABLE 38

Menarcheal age of women in America by different regions and races

INVESTIGATOR	REGION AND RACE	DATE	NO. OF CASES	MEAN AND P.E. OR AVERAGE	STD. DEV.
North America					
Engelmann	U.S. and Canada	1901	12,402	13.9 yrs.	
Baldwin	Maryland (white)	1921	134	13.6 yrs.	
Shuttleworth	Harvard (white)	1922	248	13.0 yrs.	13 mos. 6 days
Abernethy	Chicago (white)	1925	487	13.5 yrs.	13 mos. 6 days
Hotelling	California (white)	1930	157	13.55 yrs.	
Dickerson and Beam	New York (white)	1931	386	13.0 yrs.	
Gould and Gould	Louisiana (white)	1932	1,037	13.74 yrs.	
Univ. of Cincinnati	Cincinnati (white)	1930-5	1,069	13.34 ± 0.02	
Bois	New York (white)	1932	236	13.1 yrs.	14 mos. 12 days
Bois	New York (Hebrew)	1932	116	13.1 yrs.	14 mos. 12 days
Bois	New York (Hebrew, orphan)	1932	185	13.5 yrs.	13 mos. 6 days
Engle-Shelesnyak	New York (Hebrew)	1934	250	13.5 yrs.	13 mos. 6 days
Ritenour	Penn. State College (white)	1934	222	13.41 ± 0.05	
Chambers	Univ. of Kentucky (white)	1934	157	12.99 ± 0.07	
Stine	Univ. of Missouri (white)	1934	....	13 yrs.	
Univ. of Minnesota	Univ. of Minnesota (white)	1934	....	12.8 yrs.	
Mills	Montreal (white)	1935	200	13.8 yrs.	
Mills	Richmond (white)	1935	134	14.02 ± 0.09	
Mills	Richmond (colored)	1935	182	13.80 ± 0.07	
Mills	Baltimore (white)	1935	127	14.14 ± 0.11	
Mills	Baltimore (colored)	1935	109	13.60 ± 0.09	

TABLE 38 (*Continued*)

Mills	Baltimore (colored)	1935	109	13.00 ± 0.09	

TABLE 38 (*Continued*)

INVESTIGATOR	REGION AND RACE	DATE	NO. OF CASES	MEAN AND P.E. OR AVERAGE	STD. DEV.
Mills	Montreal (white)	1935	200	13.8 yrs.	
Mills	St. John, Brunswick (white)	1935	500	14.1 yrs.	
Ito	Los Angeles (Japanese)	1937-38	135	13.09 ± 0.07	1.11 ± 0.05
Haffner and Ito	Los Angeles City College	1940	2,545	12.94 yrs.	
Haffner and Ito	Los Angeles City College (Japanese)	1940	173	13.10 yrs.	
Haffner and Ito	Los Angeles City College (white)	1940	2,138	12.90 yrs.	
Haffner and Ito	Los Angeles City College (Negro)	1940	165	13.11 yrs.	
Haffner and Ito	Los Angeles City College (Mexican)	1940	52	12.55 yrs.	
Haffner and Ito	Los Angeles City College (Chinese)	1940	17	13.94 yrs.	
Central America					
Mills	Panama (Negro)	1935	188	14.13 ± 0.06	
Arrieta	Ecuador (white)	1932	367	14.01 ± 0.06	
South America					
Mattos	Brazil, San Paulo women	1934	9,010	14.63 ± 0.01	
Netto	Brazil, Bahia women	1933	1,191	13.77 ± 0.03	
Castro	Brazil, Rio de Janeiro (white)	1912	451	14.47 ± 0.05	
Castro	Brazil, Various Cities (white)	1912	1,646	14.23 ± 0.03	
Aranjo	Brazil, Rio de Janeiro	1929	2,707	14.17 yrs.	

This table was prepared from the data appearing in Mills's (C.A.) Geographic and time variations in body growth and age at menarche, HUMAN BIOLOGY, Feb., 1937; Fluhmann's (C. F.) Menstrual Disorders. Pathology Diagnosis and Treatment, W. B. Saunders Co., 1939; and Shuttleworth's (F. K.) Sexual maturation and the physical growth of girls age six to nineteen, *Monographs of the Society for Research in Child Development*, Serial No. 12, 1937.

TABLE 39

Recent data on age at menarche of Oriental women of regions outside of Japan

RACE AND LOCALITY	INVESTIGATOR	DATE	NO. OF CASES	AVERAGE AGE AT MENARCHE
Filipino Women				
Cebu	Rodriguez	1935	205	15.29 ± 0.07
Manila	Mills	1935	636	14.77 ± 0.04
Chinese Women				
Honkong	Mills	1935	464	15.21 ± 0.05
	Suen-Hsi and Gear	1934	2924	14.073 yrs.
Canton	Chau and Wright	1925	2291	14.84 ± 0.03
Fukien	Maxwell	1920	599	15.44 ± 0.11
Formosa	Yamasaki	1909	136	16.65 ± 0.11
Korean Women	Ikeda	1917	2247	15 yrs. 10 mos.
	Lee	1930	424	15.00 yrs.
Ainu Women	Yamasaki	1908	80	15 yrs. 2 mos.
	Yashiro	1928	99	15 yrs.
Hindu Women				
Calcutta	Curjel	1920	268	14.12 ± 0.07
Mussulman	Curjel	1920	140	14.14 ± 0.10

This table was prepared from the data appearing in Mills's (C.A.) Geographic and time variations in body growth and age at menarche, HUMAN BIOLOGY, Feb., 1937; Fluhmann's (C.F.) Menstrual Disorders, M. B. Saunders Company, 1939; and Fukui's (M.) Monograph on menstruation, Sairen Co., *Tokyo*.

the City College of Los Angeles is of the earliest type. The average menarcheal age for each race is found to be more or less earlier than for its respective race elsewhere, the degree of difference depending upon its racial characteristic constitutionality.

Summarizing the facts presented by this series of studies, we may conclude that the menarcheal age is decidedly influenced by the nature of the environment in which girls are reared, but the racial characteristic is retained when compared to other races.

Review of literature and comment

Before discussing the cause of acceleration of menarcheal age found in Japanese women as well as in other races in Southern California, some of the most important literature relating to this study will be reviewed.

TABLE 40

Average menarcheal ages of European women by different nationality and date

INVESTIGATOR	LOCALITY	DATE	NO. OF CASES	AVERAGE AGE AT MENARCHE
Torres	Spain-Austrian	1932	1970	15.89 ± 0.03
Vignes	France-Paris	1929	438	13.55 ± 0.05
Daria	Italy	1908	31659	14.968 yrs.
Torres	Italy-Milan	1932	246	15.16 ± 0.07
Peller and Zimmerman	Austria	1933	1763	13 to 13.5 yrs.
Schaffer	Germany	1908	11550	15.7 yrs.
Dietrich	Germany-Güssen	1920	770	14.49 ± 0.04
Scheibner	Germany	1937	1742	14 yrs. 5 mos.
Dwarzak	Czechoslovakia	1935	9949	14.46 ± 0.01
Kuczynski	Poland	1934	3667	15 yrs. 2 mos.
Bolk	Holland-Dutch Women	1923	1800	14.06 ± 0.03
Schreiner	Norway	1924	206	14.57 yrs.
Skerlj	Norway	1935	4502	14.5 yrs.
Kennedy	Scotland-Edinburgh	1933	10219	15.04 ± 0.01
Malmio	Finland-Helsinki	1919	3596	15.95 ± 0.04
Grussdeff	Russia	1904	10000	15.242 yrs.
Herstein	Russia	1917-23	434	15.85 ± 0.05

This table was prepared from the data appearing in Mills's (C.A.) Geographic and time variations in body growth and age at menarche, HUMAN BIOLOGY, Feb., 1937; Fluhmann's (C.F.) Menstrual Disorders, M. B. Saunders Company, 1939.

It is an established fact that American women menstruate earlier than European women. As early as 1901 Engelmann (50) published his results on observations of over 10,000 American-born women and found that the average menarcheal age in the United States and Canada was 13.9 years, while in the corresponding temperature zone of Europe, it was 15.5 years. Again, he found that the native American girls are more precocious than American girls born of foreign parents, although the latter, even in the first generation, closely approximate the American girls of American parents. He considers psychic influence of great importance for this acceleration of first menses, and concludes, "Climate here has practically no influence, race very little; mentality, surroundings, education and nerve stimulation stand out prominently in this country as the factors which determine precocity." Mills (51) states, "It seems fairly safe to say that nowhere on earth do girls mature so early as they now do in the central part of North America." He pointed out that the mean menarcheal age for University girls of the Middle West is now 13 years with the trend toward earlier years still in evidence. Among the entering freshman class of 1935 at the University of Cincinnati, there were 62 girls 17 years of age with a mean age at menarche of 12.94 years, and 4 girls 16

years of age whose average age at menarche was 12.5 years. In this same area body growth is also most rapid, in live stock as well as in children. He is of the opinion that here in the United States some factor in life is producing a stimulation of growth and sexual functions far in excess of that seen anywhere else on earth. He maintains that in regions characterized by a depressing moist heat, there is a delay in body growth and the menarche, whereas in a stormy temperate climate growth is more rapid and the onset of menstruation earlier.

Lintz and Markow (52) in observations on 800 cases came to the conclusion that the environment has less to do with the onset of menstruation but that heredity plays a very important rôle. Acceleration of the onset of menses from mother to daughter and the influence of heredity has been shown by Popenoe (53), later by Gould and Gould (54), and on Dutch women by Bolk (55).

The age at menarche may be constitutional in character. That the tall, heavily-built girl tends to mature earlier was observed by Baldwin (56), Gordon (57), Scheyer (58), Barker and Stone (59), Pryor (60), etc. Several other investigators, such as Boas (61), Stone and Barker (59), Shuttleworth (62), etc., have shown that a close relationship exists between somatic and sexual development, that is, those girls who commence menstruation earlier are larger than those who begin to menstruate later, and the maximum growth is intense and short in duration; they mature earlier and cease to grow earlier than the latter and the adult stature may be shorter.

That the socio-economic condition is a factor influencing the physical development and the establishment of first menses is well illustrated by a number of reports which show a significant difference in the menarcheal age of girls from different social strata. Taking examples from Europe, Tranqulli-Leali (63), for instance, conducted a study in Italy, examining the records of 10,783 women, and found that malnutrition greatly delayed the appearance of the first menstruation. An excellent example of the detrimental effect of unfavorable external conditions is found in Central European girls who attained the age of puberty during the difficult years of the war and post-war period. In 1920-21 it was found that 73.5 per cent of a group of Viennese girls between 14 and 15¼ years of age had failed to menstruate, whereas with the improved conditions of 1931, the figure was only 24 per cent. Herstein (64) found that in pre-Bolshevik Russia, the girls menstruated two years earlier than in Bolshevik Russia, the delay being due to the scarcity of food, etc. That external factors such as living conditions, occupations, diet and state of health have a profound influence upon the menarche of individuals as well as groups of women is undisputable.

The earlier menarche or constant shifting of the onset of puberty accompanying the acceleration of somatic growth of youth is a world-wide trend in most of the civilized world today. Literature concerning this is abundant. For instance, German observers such as Furst (65), Koch (66), Oster (67), Bennholdt-Thomason (68), Howe (69), and others have reported that the rate of growth of children is considerably accelerated with the early appearance of the first menses. Furst is of the opinion that the environmental factors, especially nutritional influences of a qualitative and quantitative nature, sleep, early psychic impression, injuries from school work of a psychic or somatic type are factors which are considerably responsible for the phenomenon under discussion. Kock presented the theory of

"heliogenic acceleration of human growth." It is known from biological investigations that light is capable of accelerating growth as well as maturation; since in the last two decades the value of sunlight has been emphasized in the lay and medical press, it is quite possible that exposure to sunlight and accelerated growth and earlier maturity, are constantly related. Bennholdt-Thomason advanced the following explanation of the earlier development: emigration of the restless, more lively elements from the rural community have led to a great acceleration of nervous, sensitive, impressionable types of people in the urban area. These elements have further multiplied within the city. Meanwhile the many-sided phases of urban life have exerted a cumulative effect on the more intelligent group of the population. The result has been an earlier beginning of growth and an accelerated rate of development among the youth of today. Howe considers the possibility that accelerated menarche may be related to the yearly temperature, for during the last decade the winters have become milder while the summer temperature has declined. Under this assumption an increase of the temperature has a stimulating effect upon menstruation. Another climatic factor of the same importance as the temperature in its effect upon endocrine processes and the formation of hormones and the functions of the ovaries is the radiation of the sun, especially of the ultra-violet rays, etc.

These are some of the recent studies which concern menarcheal age. It will be noticed that there is little unanimity of opinion as to the causes of its variation and its effect on the health and well-being of the life of women. However, most of the literature so far reviewed suggests that a certain relationship exists between somatic growth and onset of menses and that both of these are decidedly modified by socio-economic and other living conditions. The children of California are noted for being larger than children elsewhere in the United States. It has been shown that Japanese who were born and reared in the United States have greatly increased in body growth. This has been attributed to abundant and better food, especially milk, meats, and fruits, better housing, improved hygienic surroundings, and more sunshine and outdoor life than in Japan. The customs and habits and psychic impressions received from their associations also cannot be overlooked.

The phenomenon of the marked acceleration of menarcheal age of the American-influenced Japanese women has attracted the attention of students of human biology. From the results obtained in this study—that the acceleration of menarche of Japanese women in a different environment appeared to be coincidental with increased somatic growth in general—the inference is that the same factor (or factors) which, in a more favorable environment, causes the acceleration of somatic growth, is probably the chief causative factor (or factors) in

the acceleration of the advent of menarche. It is the natural sequence accompanying the accelerated and increased somatic growth change under the new environment.

Other facts presented in this study are that the average menarcheal age of both groups of women—those who were born and reared in the United States and those who were born in Japan, but reared in the United States from childhood—is found to be decidedly more accelerated than it is in the groups of women who were born and reared in Japan or who were born in the United States but reared in Japan from childhood. These facts indicate that the effects of the environment at birth and during infancy or childhood on the advent of catamenia will be overcome by the effect of the new environment, to which they have come to live, during the course of growth sometime before approaching puberty.

SUMMARY

Age of onset of catamenia of different groups of Japanese women who were born and reared in different environment were investigated together with that of women students at the City College of Los Angeles to find existing racial differences and to compare with the results of the present study. The average age of menarche of Group U.S.A. is found to be about 20 months earlier than that of Group Japan and Group U.S.-Japan. The dispersions are approximately the same among the groups. The average for Group Japan-U.S. is a few months earlier than that of Group U.S.A.

The racial differences in the average menarcheal age were observed among the students at the City College of Los Angeles. The average menarcheal age of each racial group appeared to be more or less earlier than that of the respective race elsewhere, showing that the southern California environment has some stimulating factor which induces an earlier age of menarche.

There is little unanimity of opinion among the leading investigators as to the causes of variation of menarcheal age and its effect on the health and other well-being of the life of women. From the facts observed in this study, it is concluded that the acceleration of menarcheal age of Japanese women in the new environment in the United States is due to the same causative factor or factors which have produced somatic growth change, namely, better and abundant foods, improved

hygienic surroundings, more sunshine and outdoor life, and habits, customs and psychic impressions received from their associations. It is an accompanying phenomenon to the increased and accelerated somatic growth under the more favorable environment.

The effects of the environment at birth and during infancy and childhood are not lasting influences on the advent of the first menses. They may be overcome by the effect of the new environment in which the individuals have come to live sometime before approaching puberty.

V. GENERAL SUMMARY AND CONCLUSIONS

Anthropometric measurements, blood pressure records and menarcheal age determinations were made on the following four groups of Japanese Women:

(1) One hundred and thirty-five Japanese women who were born and reared in the United States with an age range of 18 to 30 years (Group U.S.A.).

(2) One hundred and twenty-five American-born Japanese women who were reared in Japan from infancy and childhood and returned to the United States after establishment of menarche with an age range of 18 to 30 years (Group U.S.-Japan).

Their birthplaces in the United States and those of their parents in Japan are almost identically the same in both groups.

(3) One hundred and fifty Japanese women who were born and reared in Japan proper with an age range of 18 to 30 years, consisting chiefly of hospital nurses (Group Japan).

(4) Seven Japan-born Japanese women who were reared in the United States from infancy and childhood with an age range of 20 to 36 years (Group Japan-U.S.).

The results obtained from a comparative study are as follows:

I. *Anthropometric Measurements.* The average statures of both Group U.S.A. and Group Japan-U.S. are found to be 31 per cent higher than that of Group Japan and slightly more over the corresponding age group of Japanese women in Japan proper, that of Group U.S.-Japan being intermediate. The inference is that the increased stature is due to the effect of the more favorable environment in the United States. It is not a mere phenomenon of the process of selection.

The proper growth rate from birth to adult, which is 1:3.1 for Japanese people in Japan proper, is also observed in Group U.S.A., while Group U.S.-Japan failed to attain it, showing that the proper growth rate has been altered by changing to a different environment.

In the other linear or longitudinal measurements such as sitting height and height of trochanter, it was found that the racial characteristic of the Japanese people, high trunk and short lower extremities, is fully retained, unaffected by the increased stature in the more favorable environment.

In the lateral development of the body, those of the American influenced groups appear to be slightly favored in the new environment, except in chest circumference which is markedly inferior. Presumably this is due to the sudden markedly increased stature, a compensatory process in nature.

Head circumference of Japanese women was found to be rather stable, unaffected by the increased somatic growth under the different environment.

The American influenced groups, especially Group Japan-U.S., appear to be significantly lighter in weight than those of the Japan influenced groups, Group Japan and Group U.S.-Japan in this study, but when Rohrer's index of Group U.S.A. is compared to that of the corresponding stature class of Japanese women in Japan proper, the degree of difference is slight as compared with the measurements of the thoracic circumference which were found to be decidedly inferior in the American influenced groups.

The dispersion or variability in the statistical constants was found to be greatest throughout the series of measurements of the group of women who changed their environment during the course of growth (Group U.S.-Japan), while a selected or homogeneously composed group of women (Group Japan) was the least.

II. *Blood Pressure.* The systolic and diastolic blood pressures of Group U.S.A. and Group Japan are practically the same. That of Group U.S.-Japan is slightly lower. The result is that the pulse pressures are found to be practically the same among the three groups. The average systolic pressure of Group Japan-U.S. is between that of Group U.S.A. and Group U.S.-Japan but the higher diastolic pressure makes the pulse pressure the lowest, and about the same as that in white women. In conclusion, the blood pressure in Japanese women in the new environment is not changed to an appreciable degree in spite of the fact that there is a change in somatic growth.

III. *Menarcheal Age.* Average menarcheal age of Japanese women who were reared in the United States, whether they were born in the United States or in Japan, is found to be about 20 months earlier

than for those who were reared in Japan, whether they were born in Japan or in the United States. A racial difference of an appreciable degree is noted among college students in their average menarcheal age in Southern California; on the other hand, the average age for each race is shown to be accelerated to an appreciable degree over that of the corresponding group of the respective race elsewhere. These facts indicate that race and environment—natural and social—are the most important determining factors in menarcheal age.

Another important fact revealed in this study is that the effect of the environment at birth and during infancy and childhood is not a lasting influence for the advent of menarche but is overcome by the effect of the environment to which the individual has changed during the course of growth sometime before approaching puberty.

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AN ABRIDGED LIFE TABLE FOR THE WHITE POPULATION OF THE UNITED STATES IN 1830

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U. S. Bureau of the Census

AS part of a broader investigation of the problems of differential fertility in the United States in the early nineteenth century, it was necessary to compile a life table for that period. Such a table (even with the radix at age 5) made it possible to compute approximate net reproduction rates for this period, one of the principal aims of this study of differential fertility.[1] A careful examination of the literature revealed neither death rates nor suitable life tables for the nineteenth century except for Massachusetts, and even for this State there was no table for the early nineteenth century.[2] We therefore attempted to assemble data from scattered sources which would enable us to construct some sort of table, however abridged, knowing that, although it would be deficient from the strictly actuarial viewpoint it would be adequate as a basis for an approximate net reproduction rate.

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[1] Using the children under 5 years of age as reported in the Population Census, instead of the number of births, affords a group which has on the average experienced about the first 2½ years of mortality. Since almost all of the mortality under 5 years of age occurs during the first 2½ years of life, it is then possible to compute the net reproduction rate on the basis of a life table beginning with age 5 (and the number of children 0 to 4 years of age) which would be almost as accurate as a rate based on the number of births and a life table beginning with age 0.

[2] Several life tables have been constructed by various students, but all are deficient. See L. I. Dublin and A. J. Lotka. Length of Life, Ronald Press, *New York*, 1936. Carl E. Jones estimated the life expectancy for this early period (A genealogical study of population. *J. Am. Stat. Assoc.*, Vol. 16, 1918-19, pp. 201-220) but such a figure is unsuitable for computing the net reproduction rate.

DATA AND METHODOLOGY

Source of data

The year 1830 was the first for which the United States Census of Population presented age data in sufficient detail to make the construction of an abridged life table possible. These data were presented by sex and color for five-year periods up to age 20, and thenceforward in ten-year age periods. Since no such detailed figures had been shown in prior censuses, we attempted to find death statistics which would permit the construction of a life table centered on 1830.

From the beginning it was obvious that statistics on deaths could not be obtained for the entire United States, but only for selected areas. Our quest for possible sources of such data led us to the records maintained by the Library of Congress in Washington, D. C. For genealogical purposes numerous compilations of early death records have been made for a number of towns, counties, and other political divisions of the Nation. Such compilations are derived from official records, the newspapers of those days, church records, family Bibles, gravestones, and all other possible sources. Each volume dealing with a specified locality lists the names of the persons who died, the year of death, usually the age, and sometimes additional information such as sex, and relationship. It was thus easy to tally the white deaths for the years 1826 to 1835 inclusive and to distribute them by the same age groups as those presented in the 1830 Census volume. A number of such tallies were made.

Occasionally we obtained tallies with no deaths in a given age group. Whenever a rough calculation revealed that it was highly improbable that no deaths had occurred in that age group, such tallies were discarded. If the number of deceased persons of unknown age mounted to ten percent or more of all deaths, the tally was likewise rejected. If those of unknown age constituted less than ten percent of the total, however, they were distributed by age in the same proportions as were the deaths of known age. In all, deaths of persons of unknown age constituted only 7.4 percent of all the deaths compiled from these genealogical records. In the aggregate, age distributions of deaths for the years 1826 to 1935 inclusive were obtained from the genealogical records for 46 rural towns, varying in size from 198 to 3,816, and for Salem, Massachusetts (13,895) and New Haven,

Connecticut (10,180). The complete list of towns, with their location, population, and number of deaths, is given in the appendix, Table 1.

In addition to these compilations, lists of deaths by age were already extant for the cities of Boston, New York, and Philadelphia. These distributions referred to the same years as the data for the smaller places, 1826 to 1835 inclusive.

Inspection of the age distributions of deaths revealed the data to be inadequate in the youngest and oldest age groups. Accordingly, we did not attempt to compute death rates for persons under five years of age or over 79. Furthermore, complete lists of deaths by sex could not be readily obtained; hence abridged life tables were constructed only for the two sexes combined.

The geographic area for which death records were obtainable roughly coincide with the States included in the original death registration area. Parts of New Hampshire, Vermont, Massachusetts, Connecticut, New York, and Pennsylvania were represented. Massachusetts, however, had the largest collection of accessible genealogical records; therefore deaths from this State formed a larger proportion of the total number analyzed than would be justifiable under strict sampling procedure.

Construction of tables

The abridged life tables, consisting only of the death rate and survivorship columns, were constructed in a very simple manner. No attempt was made to smooth either the age distributions as reported by the census, or the statistics of deaths by age as compiled. One average annual death rate for each five or ten-year age group was computed. On the basis of these death rates the survivorship column was derived as follows. Beginning with a radix of 10,000 at age 5, the expected number dying between age 5 and 10 was computed and subtracted from 10,000, the remainder being the number expected to survive to age 10. This process was repeated for each succeeding age group until the age of 80. Three such tables, comprising both sexes between the ages of 5 and 80, were made for 1830. One was for all the small towns (ranging in size from 198 to 3,816), another for the towns of Salem and New Haven, and a third for the cities of Boston, New York and Philadelphia combined. These three life tables were then separately weighted by the urban-rural distribution of the total

population of the United States and a fourth life table was constructed for the entire country.

THE 1830 LIFE TABLE

Table 1 presents the death rates by age and the number of survivors (beginning with age 5) at the beginning of each age period, for the rural population, Salem and New Haven, and the three large cities. These rates are graphically presented in Fig. 1A and 1B.

Without exception, the age-specific death rates were lowest in the rural areas and highest in the large cities, New York, Boston, and Philadelphia, with the rates for the two small cities in an intermediate position. The high death rates observed in the large cities bear out what is known of public health conditions at the time,[3] but it is impossible to prove whether the death rates in the rural areas were actually as low as those found in this study. (As will be shown presently, there is evidence that our computed rates are fairly valid.) It is certain that the true rural rates were considerably below those for the cities, whether they agree with our computed rates or not.

It should also be noted that the patterns formed by the death rates in each of the three residence areas are in accordance with those expected. The death rate normally decreases from the age group 5 to 9 to the age group 10 to 14, after which it increases regularly with advancing age. This U-shaped curve has been observed in all life tables based on valid data.[4] The fact that our death rates for 1830 form this pattern is further evidence of their validity.

Finally, it should be mentioned that in all probability the death rates, if not accurate, are too low rather than too high; that is, it is likely that deaths were under-reported rather than over-reported.

Examination of the lower tier of Table 1 reveals more clearly the cumulative effects of mortality at the various age levels. Out of the original cohort at age 5 in the rural areas, half would be dead by about age 65; in the smaller cities half would be dead by about age 56; and in the three largest cities half would be dead by about

[3] See H. E. Sigerist, American Medicine, W. Norton and Co., Inc., *New York*, 1934, pp. 84-85, for a description of a yellow fever epidemic in Philadelphia and the public health facilities and medical knowledge available at the time for combating the epidemic. See also R. H. Shryock, The Development of Modern Medicine, Univ. of Pennsylvania Press, Philadelphia, 1936, Chapter XII.

[4] Dublin and Lotka, Chapter I.

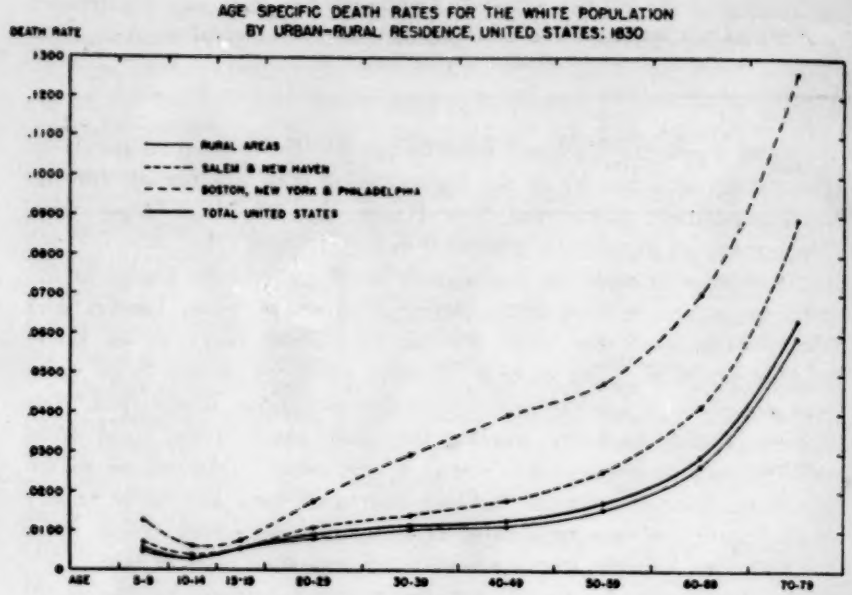
AGE SPECIFIC DEATH RATES FOR THE WHITE POPULATION
BY URBAN-RURAL RESIDENCE, UNITED STATES: 1830
DEATH RATE
.1300
.1200
.1100
.1000
.0900
.0800
.0700
.0600
.0500
.0400
.0300
.0200
.0100
0
RURAL AREAS
SALEM & NEW HAVEN
BOSTON, NEW YORK & PHILADELPHIA
TOTAL UNITED STATES
AGE
5-9
10-14
15-19
20-29
30-39
40-49
50-59
60-69
70-79

Fig. 1A

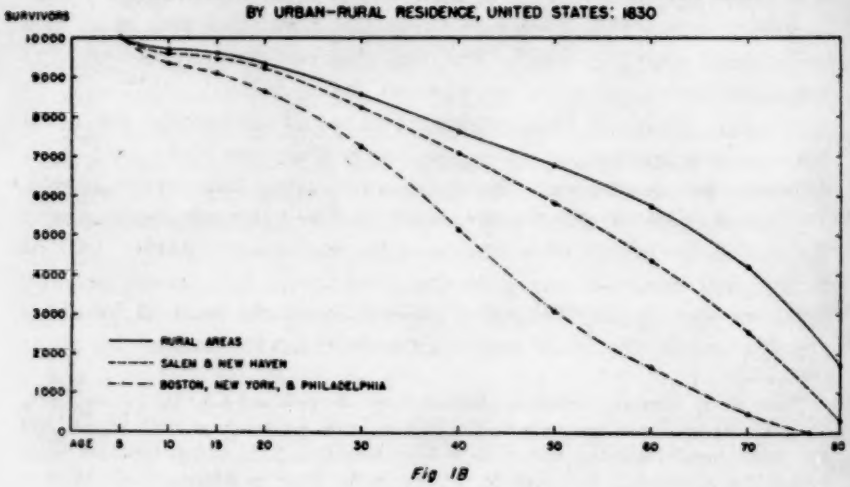
SURVIVORS FROM AGE 5 TO SPECIFIED AGES FOR THE WHITE POPULATION
BY URBAN-RURAL RESIDENCE, UNITED STATES: 1830
SURVIVORS
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
RURAL AREAS
SALEM & NEW HAVEN
BOSTON, NEW YORK, & PHILADELPHIA
AGE
5
10
15
20
30
40
50
60
70
80

Fig 1B

TABLE 1

Abridged life tables for the white population, by urban-rural residence, United States: 1830

AGE	TOTAL UNITED STATES[1, 2]	RURAL AREAS[1]	SALEM AND NEW HAVEN[1]	BOSTON, NEW YORK AND PHILADELPHIA[1]
		Death rate		
5-9	.0055	.0051	.0071	.0125
10-14	.0030	.0029	.0033	.0058
15-19	.0054	.0053	.0054	.0074
20-29	.0089	.0084	.0107	.0173
30-39	.0115	.0105	.0140	.0292
40-49	.0126	.0112	.0179	.0393
50-59	.0172	.0155	.0250	.0472
60-69	.0290	.0265	.0412	.0700
70-79	.0633	.0591	.0888	.1259
		Number alive at beginning of age		
5	10,000	10,000	10,000	10,000
10	9,725	9,745	9,645	9,375
15	9,580	9,605	9,485	9,105
20	9,320	9,350	9,230	8,770
30	8,490	8,560	8,240	7,250
40	7,510	7,660	7,090	5,130
50	6,560	6,800	5,820	3,110
60	5,430	5,750	4,360	1,640
70	3,860	4,230	2,560	490
80	1,420	1,730	290	....

[1] For source of data see text and appendix, Table II.

[2] Weighted average of the rates for the three urban-rural areas. The weights applied were as follows: rural areas, .912; Salem and New Haven, .047; and Boston, New York, and Philadelphia, .041.

age 41. It is thus apparent that mortality conditions were far worse in the large cities than in the small cities or the rural areas.

In order to obtain a single set of age-specific death rates and survival rates for the entire United States (presented in the first column of Table 1), each of the three sets of rates was weighted by the proportion of the total population living in that area. Since the Nation was predominantly rural, the life table for the entire Nation closely parallels that for the rural areas.

TRENDS IN MORTALITY IN THE UNITED STATES FROM 1830 TO 1930

The total population

It was found possible to adjust our life tables for 1830 and the published ones for the original registration States for 1901, 1910, and 1930 so that all of them would have the same sex distribution as the 1830 table and the same urban-rural distribution as the 1930 table. Hence the life tables for these four periods may be considered as fairly comparable as regards sex and urban-rural distribution. Since all the life tables refer to the white population only, the factor of color is also held constant. The weighted age-specific death rates and the abridged life tables are shown in Table 2.

Since 1830 there has been a steady improvement in mortality.[5] With but two exceptions (occurring in 1910), the age-specific death rates have consistently decreased since 1830. The number of persons from the original cohorts surviving to the higher age levels has also steadily increased during the last century.

We may summarize the trend in mortality by noting the median life expectancy—the age at which half the persons living at the age of five would be dead—if sex and urban-rural distribution were held constant. In 1830, half of a group of people living at the age of five would have died at some time between the ages of 40. and 50. In 1901 half of the persons living at the age of five would have died between their sixtieth and seventieth birthdays. This was also true for 1910 and 1930. The respective median expectancies for these four years were approximately 46, 62, 63, and 67. It is thus apparent that there was a greater improvement in the rate of mortality between 1830 and 1901 than in the subsequent years.

The rural population[6]

Comparisons between these various periods based on the total population may obscure a number of significant differences between urban and rural areas. Since the urban and rural populations could be studied

[5] See also Dublin and Lotka, Chapter VIII, "The contribution of medical and sanitary science to human longevity."

[6] It should be noted that the definition of rural areas has not been constant throughout this period. For 1830 it referred to the persons living in places of less than about 2,500 population. In 1901 "rural" included places of less than 8,000 population, and in 1910 those of less than 10,000 population.

separately for 1830, 1901, and 1910 only, this analysis will have to be limited to these periods.

In the various ages under 60 there has been a steady decrease in rural age-specific mortality rates (standardized for sex) between 1830 and 1910. Most of this improvement in mortality, of course, occurred between 1830 and 1901 (Table 3).

TABLE 2

Abridged life tables for the white population, United States: 1830, 1901, 1910, 1930
(1901, 1910, and 1930 standardized on the basis of the sex composition in 1830. 1830, 1901, and 1910 standardized on the basis of the urban-rural composition in 1930.)

AGE	1830[1]	1901[2]	1910[2]	1930[3]
		Death rate		
5-9	.0091	.0044	.0035	.0019
10-14	.0046	.0027	.0023	.0014
15-19	.0065	.0045	.0034	.0022
20-29	.0131	.0069	.0055	.0032
30-39	.0204	.0091	.0077	.0046
40-49	.0266	.0125	.0114	.0085
50-59	.0333	.0214	.0206	.0174
60-69	.0510	.0419	.0426	.0375
70-79	.0961	.0865	.0880	.0822
		Number alive at beginning of age		
5	10,000	10,000	10,000	10,000
10	9,545	9,780	9,825	9,905
15	9,325	9,650	9,710	9,835
20	9,020	9,435	9,545	9,725
30	7,840	8,785	9,025	9,415
40	6,240	7,985	8,335	8,985
50	4,580	6,985	7,385	8,225
60	3,050	5,495	5,865	6,795
70	1,490	3,195	3,365	4,245
80	60	435	405	755

[1] For source of data see text.

[2] Original data from James W. Glover, United States Life Tables, *Washington*, United States Government Printing Office, 1921.

[3] Original data from United States Life Tables, prepared under the supervision of Joseph A. Hill, *Washington*, United States Government Printing Office, 1936.

In contrast, the age-specific mortality rates for the age groups over 60 increased between 1830 and 1910. Whether this means that the death statistics for the early period were deficient, or that there was a rise in the true death rates, we cannot say. Perhaps the decrease in mortality in the earlier age groups has resulted in the survival of less "hardy" persons to higher ages, thereby increasing the age-specific rates at the upper age levels.[7]

Because mortality has decreased in the lower ages and increased in the age groups above 60, the age at which half of the original cohort would be dead has remained almost unchanged since 1830. At that date half of the persons living at age 5 would have been dead by about age 65; in 1901 and 1910 half would have been dead by about age 68.

The large cities

The combined population of Boston, New York, and Philadelphia could be studied for 1830, 1901, and 1910. The rates for the white populations (standardized for sex) are shown in Table 4. The most noteworthy characteristic is that the age-specific death rates, without exception, have decreased considerably since 1830. Indeed, in some of the younger age groups the decreases ranged from one-half to two-thirds between 1830 and 1910.

Because all of the age-specific rates decreased since 1830, the cumulative number of survivors has increased considerably at each age period. Thus in 1830 half of the original cohort would have died by about age 41; by 1910, however, the median age had increased to 57, and by 1910 to 60.

That these data betoken true and significant improvements in mortality experience since 1830 is beyond question. Accounts of the cities of that period are unanimous in describing sanitary conditions which could not fail to result in a very high mortality. The public health movement was not yet under way. Water and milk supplies were often contaminated, and little or no provision was made for the dis-

[7] For discussions of the selective aspects of mortality see, for example, S. J. Holmes, Human Genetics, McGraw-Hill Book Company, Inc., *New York*, 1936, chapter XIX; I. S. Falk, Does infant welfare work operate to preserve the unfit? *Am. J. Pub. Health*, Vol. 17, No. 2, pp. 142-147; and Charles Herrman, Infant mortality and the survival of the fittest, *Scient. Monthly*, Vol. 22, No. 1, pp. 25-29.

TABLE 3

Abridged life tables for the rural white population, United States: 1830, 1901, 1910
(1901 and 1910 standardized on the basis of the sex composition in 1830.)

AGE	1830[1]	1901[2]	1910[2]
	Death rate		
5-9	.0051	.0031	.0026
10-14	.0029	.0025	.0021
15-19	.0053	.0042	.0033
20-29	.0084	.0060	.0052
30-39	.0105	.0066	.0061
40-49	.0112	.0085	.0081
50-59	.0155	.0144	.0145
60-69	.0265	.0311	.0324
70-79	.0591	.0743	.0777
	Number alive at beginning of age		
5	10,000	10,000	10,000
10	9,745	9,845	9,870
15	9,605	9,720	9,765
20	9,350	9,515	9,605
30	8,560	8,945	9,105
40	7,660	8,355	8,545
50	6,800	7,645	7,855
60	5,750	6,545	6,715
70	4,230	4,505	4,535
80	1,730	1,155	1,015

[1] For source of data see text.

[2] Original data from James W. Glover, United States Life Tables, *Washington*, United States Government Printing Office, 1921.

posal of refuse. Epidemics were of frequent occurrence and almost the only known method of checking them was quarantine.[8]

Age differential trends

The greatest improvements in mortality experience occurred in the younger age groups. In the rural areas mortality rates decreased

[8] For a description of health conditions in Philadelphia around 1800 see: Not so long ago, by Cecil K. Drinker in The March of Medicine, *New York*, Columbia Univ. Press, 1940. The descriptions presented are based on diary records.

by one-third to one-half between 1830 and 1910 in almost every age group under 40. In the two following age groups mortality rates fell somewhat less, and in the two oldest age groups, 60 to 69 and 70 to 79, they increased between 1830 and 1910.

In Boston, New York, and Philadelphia age-specific mortality decreased by one-half to two-thirds between 1830 and 1910 in all age groups under 60. In the two oldest age groups the mortality rates decreased by only one-fourth.

These differential trends agree with those observed in England and other countries as reported in Dublin and Lotka. Indeed, the

TABLE 4

Abridged life tables for the white populations of Boston, New York, and Philadelphia combined: 1830, 1901, 1910
(1901 and 1910 standardized on the basis of sex composition in 1830.)

AGE	1830[1]	1901[2]	1910[2]
	Death rate		
5-9	.0125	.0058	.0041
10-14	.0058	.0029	.0024
15-19	.0074	.0048	.0036
20-29	.0173	.0081	.0058
30-39	.0292	.0119	.0096
40-49	.0393	.0167	.0149
50-59	.0472	.0280	.0262
60-69	.0700	.0519	.0511
70-79	.1259	.0993	.0947
	Number alive at beginning of age		
5	10,000	10,000	10,000
10	9,375	9,710	9,795
15	9,105	9,570	9,675
20	8,770	9,340	9,500
30	7,250	8,580	8,950
40	5,130	7,560	8,090
50	3,110	6,300	6,880
60	1,640	4,540	5,080
70	490	2,180	2,480
80	....	20	130

[1] For source of data see text.
[2] Original data from James W. Glover, United States Life Tables, *Washington*, United States Government Printing Office, 1921.

American experience agrees with the statement made by these two authors: " . . This feature of gains [in life expectancy] at the early ages and losses [in life expectancy] at the higher ages is characteristic of the entire trend of longevity."[9]

COMPARISON OF THE UNITED STATES, 1830, AND SELECTED FOREIGN COUNTRIES

Examination of the literature revealed life tables for three countries which were fairly comparable with the 1830 United States table. Life tables, by sex, were extant for Sweden (1755-63), the Netherlands (1816-25 and 1840-51), and Russia (1874-83). It was possible to standardize these tables for sex and consolidated age groups so as to make comparisons possible. The standardized life tables are presented in Table 5.

Without exception the age-specific death rates were lower and the number of survivors at any given age level in the United States was greater than in any of the other countries. The age at which half of the original cohorts would be dead was about 63 for the United States, 55 for Sweden, 51 for the Netherlands in the period of 1816-25, 55 for the Netherlands in the period 1840-51, and 54 for Russia. Whether the better mortality conditions in the United States reflect improved public health methods and better living conditions, a smaller proportion of urban population, a lesser degree of industrialization, or simply deficient mortality statistics is difficult to say.

The effects of the urban-rural distribution can be partially studied by comparing the rural and urban rates for the United States with those for other countries. Comparison of the American rural age-specific death rates with those for Sweden (excluding Stockholm) and for Russia, which was predominantly rural, reveals consistently lower rates in the United States than in either of the other two countries. The numbers surviving to the various age levels are also consistently higher in the United States than in either Sweden or Russia. The ages at which half of the original cohorts would be dead are about 65 in the United States, 56 in Sweden, and 54 in Russia (Table 6).

Mortality in the cities of Boston, New York, and Philadelphia could be compared with that in Stockholm and Liverpool. Without exception the combined age-specific rates for the three American

[9] Dublin and Lotka, 50.

TABLE 5

Abridged life tables for the white populations of selected countries
(Foreign life tables standardized on the basis of the sex composition in the United States in 1830.)

AGE	UNITED STATES[1] (1830)	SWEDEN[2] (1755-1763)	NETHERLANDS[3] (1816-1825)	NETHERLANDS[3] (1840-1851)	RUSSIA[4] (1874-1883)
			Death rate		
5-9	.0055	.0142	.0110	.0102	.0155
10-14	.0030	.0072	.0047	.0054	.0064
15-19	.0054	.0069	.0062	.0069	.0066
20-29	.0089	.0092	.0133	.0103	.0087
30-39	.0115	.0123	.0161	.0126	.0112
40-49	.0126	.0175	.0208	.0172	.0172
50-59	.0172	.0266	.0318	.0252	.0316
60-69	.0290	.0487	.0555	.0505	.0630
70-79	.0633	.1026	.1113	.1169	.1070
			Number alive at beginning of age		
5	10,000	10,000	10,000	10,000	10,000
10	9,725	9,290	9,450	9,490	9,225
15	9,580	8,955	9,230	9,235	8,930
20	9,320	8,645	8,945	8,915	8,635
30	8,490	7,845	7,755	7,995	7,885
40	7,510	6,885	6,505	6,985	7,005
50	6,560	5,685	5,155	5,785	5,805
60	5,430	4,175	3,515	4,325	3,975
70	3,860	2,145	1,565	2,145	1,475
80	1,420	....	....	....	....

[1] For source of data see text.

[2] Original data from Richard Price, Observations on Reversionary Payments, II: 404, *London*, 1812.

[3] Original data from *Proc. of the Fourth Internat. Congress of Actuaries*, Vol. I. *New York*, Actuarial Society of America, 1904.

[4] Original data from L. von Bortkewitsch, Russische Sterbetafeln, in *Allg. stat. Archiv*, 3: 23-65, *Tübingen*, 1894.

cities were lowest in the age groups under 20 and over 60. In the intermediate age groups Liverpool had the lowest age-specific rates. Examination of the l_x columns reveals larger numbers surviving to each age level in the American cities than in Stockholm. In Liverpool, on the other hand, there were fewer survivors at age 20 and more survivors in the older age groups than in the American cities (Table 7). In

short, half of the original cohort would have died by about 41 in the American cities, by 36 in Stockholm and by 49 in Liverpool.

In conclusion, we may note that such evidence as exists tends to corroborate the assumption that mortality conditions were better in this country than in many of the European nations. This difference is probably due to a number of factors which may be summarized in the words of Seybert, an American writer of the early nineteenth century:

TABLE 6

Abridged life tables for the rural white populations of the United States and Sweden
(Swedish life table standardized on the basis of the sex composition in rural United States, 1830.)

AGE	RURAL UNITED STATES[1] (1830)	RURAL SWEDEN[2] (1755-1763)
	Death rate	
5-9	.0051	.0139
10-14	.0029	.0071
15-19	.0053	.0068
20-29	.0084	.0088
30-39	.0105	.0114
40-49	.0112	.0167
50-59	.0155	.0259
60-69	.0265	.0477
70-79	.0591	.1026
	Number alive at beginning of age	
5	10,000	10,000
10	9,745	9,305
15	9,605	8,975
20	9,350	8,670
30	8,560	7,910
40	7,660	7,010
50	6,800	5,840
60	5,750	4,330
70	4,230	2,260
80	1,730	....

[1] For source of data see text.

[2] Original data from Richard Price, Observations on Reversionary Payments, II: 404 ff., *London*, 1812.

The causes which have checked the progress of the population in other countries, have been more limited in the United States. The great mass of our people is composed of agriculturalists and our commerce is supported chiefly by the surplus of their industry. Few of our citizens are concerned in unhealthy occupation; our towns and cities are not yet so large as to endanger the health of their inhabitants; fatal epidemics have not been very prevalent; property is much divided amongst the people, and a very moderate share of industry will enable every individual to gain his support.[10]

TABLE 7

Abridged life tables for the white populations of selected cities
(Stockholm and Liverpool life tables standardized on the basis of the sex composition of Boston, New York, and Philadelphia: 1830.)

AGE	BOSTON, NEW YORK, AND PHILADELPHIA[1] (1830)	STOCKHOLM[2] (1755-1763)	LIVERPOOL[3] (1841)
	Death rate		
5-9	.0125	.0272	.0166
10-14	.0058	.0106	.0062
15-19	.0074	.0116	.0083
20-29	.0173	.0204	.0105
30-39	.0292	.0297	.0158
40-49	.0393	.0400	.0247
50-59	.0472	.0512	.0370
60-69	.0700	.0809	.0740
70-79	.1259	.1512	.1450
	Number alive at beginning of age		
5	10,000	10,000	10,000
10	9,375	8,640	9,170
15	9,105	8,180	8,885
20	8,770	7,705	8,515
30	7,250	6,135	7,625
40	5,130	4,315	6,425
50	3,110	2,585	4,835
60	1,640	1,265	3,045
70	490	245	795

[1] For source of data see text.

[2] Original data from Richard Price. Observations on Reversionary Payments, II: 404 ff., *London*, 1812.

[3] Original data from Seventh Annual Report of the Registrar-General of England, *London*, 1846.

[10] Adam Seybert, Statistical Annals of the United States of America, *Philadelphia*, 1818.

How accurate these remarks of Seybert's are, we cannot tell. Certainly a number of these factors were operative, but only a very detailed analysis of health, living conditions, and planes of living in the United States and the various European countries could disentangle the various factors influencing mortality experience. Such an analysis is beyond the scope of this paper.[11]

SUMMARY

On the basis of the foregoing study, the following conclusions appear to be justified:

(1) Age-specific death rates in 1830 were highest in large cities, lower in small cities, and lowest in small towns and rural areas.

(2) Mortality conditions improved more in the period 1830 to 1901 than in the subsequent period 1901 to 1930.

(3) Mortality conditions have improved more in the younger than in the older age groups.

(4) Mortality conditions have improved more in the large cities than in the rural areas.

(5) Mortality in the United States in 1830, though high by present standards, was probably more favorable than in many European countries at that time.

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[11] For a general picture of health conditions and medical knowledge in early United States, see Sigerist, *op. cit.*, and Shryock, *op. cit.*

APPENDIX TABLE I

White populations in 1830, and numbers of deaths 1826-1835, for selected cities and towns

CITY OR TOWN	TOTAL WHITE POPULATION 1830	TOTAL DEATHS REPORTED; ALL AGES, 1826-1835	CITY OR TOWN	TOTAL WHITE POPULATION 1830	TOTAL DEATHS REPORTED; ALL AGES, 1826-1835
		I. *Small towns*			
Amherst, N. H.	1649	293	Holden, Mass.	1719	297
Berlin, Mass.	692	101	Holliston, Mass.	1304	257
Boxborough, Mass.	474	44	Hull, Mass.	198	22
Boxford, Mass.	935	212	Kingston, Mass.	1321	215
Burlington, Mass.	446	22	Lee, Mass.	1825	284
Carver, Mass.	970	130	Lynnfield, Mass.	617	30
Chester, Mass.	1407	184	Manchester, Mass.	1236	252
Chilmark, Mass.	691	56	Mansfield, Mass.	1172	197
Dalton, Mass.	827	70	Middlefield, Mass.	720	112
Dana, Mass.	623	38	New Braintree, Mass.	825	123
Deerfield, Mass.	2003	323	Newport, N. H.	1913	283
Dover, Mass.	497	52	Oakham, Mass.	1010	158
Essex, Mass.	1333	151	Phillipston, Mass.	932	133
Fitzwilliam, N. H.	1229	196	Richmond, Mass.	844	140
Gardner, Mass.	1023	114	Shelburne, Mass.	995	157
Gill, Mass.	864	82	Tisbury, Mass.	1317	120
Gilmanton, N. H.	3816	445	Topsfield, Mass.	1010	149
Greenfield, Mass.	1540	210	Wenham, Mass.	611	128
Hamilton, Mass.	748	144	West Stockbridge, Mass.	1209	167
Hanson, Mass.	1030	133	Windsor, Mass.	1042	152
Hardwick, Mass.	1885	259	Worcester, Vt.	432	33
Harvard, Mass.	1600	201	Worthington, Mass.	1179	161
Henniker, N. H.	1725	283			
Hinsdale, Mass.	780	105			
		II. *Small cities*			
Salem, Mass.	13,895	2518	New Haven, Conn.	10,180	1704
		III. *Lagre cities*			
New York	197,112	64,618	Philadelphia & Liberties	109,334	47,443
Boston	61,392	13,107			

APPENDIX TABLE II

White populations, numbers of deaths, and average annual death rates, by age and urban-rural residence, United States: 1830

AGE	RURAL AREAS			SALEM AND NEW HAVEN			BOSTON, NEW YORK, & PHILADELPHIA		
	Population	*Number deaths, 1826-35*	*Average annual death rate*	*Population*	*Number deaths, 1826-35*	*Average annual death rate*	*Population*	*Number deaths, 1826-35*	*Average annual death rate*
5-9	5,911	304	.0051	2,508	179	.0071	39,841	4,988	.0125
10-14	5,198	149	.0029	2,564	84	.0033	36,097	2,100	.0058
15-19	4,730	252	.0053	3,258	175	.0054	43,602	3,209	.0074
20-29	8,900	750	.0084	5,101	544	.0107	87,712	15,192	.0173
30-39	5,950	626	.0105	2,874	402	.0140	53,400	15,598	.0292
40-49	4,509	506	.0112	2,142	383	.0179	27,697	10,887	.0393
50-59	3,114	482	.0155	1,357	339	.0250	14,949	7,051	.0472
60-69	2,290	607	.0265	724	298	.0412	7,527	5,270	.0700
70-79	1,401	828	.0591	403	358	.0888	2,844	3,581	.1259

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AN ANALYSIS OF THE CONCEPTION OF RACE AND A NEW METHOD OF DISTINGUISHING RACES

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INTRODUCTION

FROM olden times, political viewpoints have played a part in racial research. This is perhaps one of the reasons why our knowledge of the races of mankind is so inadequate. Scientists are not as a rule particularly attracted by problems which are connected with political-social divergencies, and which therefore may provoke emotionally colored criticisms from scholars and the uninitiated alike. It is more peaceful to occupy oneself with questions not open to dispute from persons with preconceived ideas.

As early a scholar as Linnaeus took account in his systematization of the races of mankind, without, however, devoting any special attention to the problems. He singled out some few primary races: Ferus, Americanus, Asiaticus, Européus, Afer, Monstruosus. In his first grouping, in 1735, he ascribed differences of temperament to the races: thus, Asiaticus was "melancolicus", Européus, "sanguinicus"; Afer, "phlegmaticus"; etc. In a later grouping, such qualities were not included. Formerly, only the main races were, on the whole, discussed, so that more exact definitions were hardly necessary: the diagnosis was clear in each separate case. No one confuses a Negro with a European. Nevertheless, political viewpoints made themselves felt at this stage too. Soemmering, who was one of the first to carry out comparative anatomical investigations of Negro and European, maintained that the differences he found between them did not allow of the conclusion that Negroes are not human beings, and that these differences could not be used to justify slavery. He said: "Um alle gehässige Schlüsse und Missbräuche vorzubeugen, wiedrhole ich nochmals: die Neger sind

wahre Menschen so gut wie wir." A French theologian published a letter denouncing Soemmering, in which he said: "I know this anatomist; he in an ignorant person, a man without logic, who has never taken the trouble to study the science he represents". Readers may remember that Soemmering enjoys no little repute on account, *inter alia*, of his cerebro-anatomical researches. It is he who has given the name to "Substantia nigra soemmeringi".

One need not go further into the history of anthropology. I shall confine myself to a reminder that it was Blumenbach, Professor of Medicine in Göttingen (he is called the father of anthropology), who introduced a measuring technique, and that the Swede Anders Retzius has played a part by introducing the cephalic index, i. e. the breadth of the head in percentage of its length, as a characteristic which can be used to differentiate between races.

Pre-Mendelian conception of race

The modern race doctrines, which undertake to differentiate not only main races but also racial groups very close to one another, were given an effective impetus by Count Gobineau, French minister in Stockholm, 1872-77. Gobineau was not a scientist; his interests were literary and historical. In his work *Essai sur l'inégalité des races humaines* he maintained that the reason for differences in the cultural level between different peoples is linked up with their racial differences. The white race is responsible for all civilization, etc. In his view, the white or Aryan race came from Asia, in which continent he had a marked interest. He also published a collection of Asiatic tales which, however, are hardly as fanciful as might have been expected from a man who set up so rashly speculative a theory of race. Among those who have played a political rôle in the popularization of racial viewpoints may also be mentioned Houston Stuart Chamberlain, who in *Die Grundlagen des neunzehnten Jahrhunderts* assserts that all great men belong to the Nordic race, which is the foremost vehicle of civilization. He is further known for having very heatedly launched the peculiar view that Christ was not a Jew. "Die Wahrscheinlichkeit, dass Christus kein Jude war, dass er keinen Tropfen echt jüdischen Blutes in den Adern hatte, ist so gross, dass sie einer Gewissheit fast gleichkommt."

Scholars concerned with scientific racial research have concentrated on the measuring technique. To begin with, crania were primarily

measured. Nowadays, well over 500 different measurements can be distinguished on a cranium, and, according to certain authors, such as the Hungarian von Török, infinitely more. Gradually the measuring process was applied to living persons and a number of investigations have been carried out. At the same time the older race division was extended and improved. In systematics of the human race nowadays a large number of subdivisions are used. The question we are then forced to discuss somewhat is: When is one justified in saying that a group of people belong to a certain race? Speaking generally, it has been agreed that a race is characterized by differences conditioned by heredity. Qualities conditioned by environment are not considered racial characters. It may, however, be remembered that Martin, who played a leading part in anthropology, wished, when characterizing races, to attribute a rôle to these last-named qualities also. In contradistinction to Lenz, who contends that "Rasse ist der Inbegriff der Erbenlagen", he says that qualities of paratypical kind (i. e. those determined by environment) can be used as racial characteristics. Martin is, however, quite alone in this view.

The definition, then, that is as a rule more or less clearly followed is that a race is a group of individuals who differ from other groups as regards hereditary qualities. Such a definition seems to be clear. Actually, however, it is rather vague in several respects. In addition, various supplementary assumptions are also used in scientific works when speaking of race, so that there is reason for aiming at a clearer definition, at the same time that we try to find out the implications of the conception of race as it is actually used.

To begin with, then, we can state that a racial characteristic is significant only if it is missing in some race. Hereditary qualities such as having two legs, two arms, or even a heart, cannot be used as racial characters, seeing that they are common to all. Strictly speaking, it is impossible to talk of racial qualities; we can only talk of racial differences. A quality which is not a racial quality to-day may become one tomorrow if a group can be discovered lacking the quality in question. This side of the matter is, however, of less importance.

What is of more importance is the question of which hereditary differences can be used as race differences. It is obvious that not all differences due to heredity can be used, since in that case every individual would come to form his own race. At the bottom of our

hearts we feel ourselves unlike everyone else and possessed of special qualities which others do not have. Consequently we must say that some qualities can constitute racial differences, others not; and our job is then to ascertain empirically whether there are group differences in regard to the qualities in question. When trying to acquaint ourselves with what is actually known about racial differences, we are, however, struck by the scantiness of the empirical foundation which supports a constructive fabric of a very airy nature. Direct and documented observations are mainly to be found when dealing with certain primitive races. As regards the population of Europe, our knowledge is extremely patchy. In spite of this, racial theories have been developed, particularly in more recent times, with very detailed characterization of different races, both as regards the psychic and the physical aspect. To take an extreme example, it may be mentioned that Günther (1922) reports that the soul in the Dinaric race seems to be dark green. ("Als 'seelische Farbe' der dinarischen Rasse scheint sich ein dunkles Grün zu ergeben.") Günther was awarded the Goethe medal for art and science in 1941.

There must be some explanation of the fact that, in questions of the human race, the usual scientific method of working has been abandoned in favor of uncritical speculations. As far as I can see, one of the fundamental reasons for this is that, anthropologically, antiquated and inaccurate ideas as to heredity have been used. The current race doctrines build, as a matter of fact, on pre-Mendelian views. Before Mendel it was assumed that the inheritable matter is a substance, and that, in the process of crossing, the hereditary substances are mixed as when fruit juice and water are mixed. If a Negro is crossed with a white man, a simple dilution takes place, and the result is a mulatto. Half-bloods are then spoken of. If mulattoes are crossed, the result according to the older substance doctrine ought to be solely mulattoes, in the same way as, when two glasses of fruit juice of the same concentration are mixed, one does not expect to get any difference in the color. As a matter of fact, the crossing of mulattoes gives offspring ranging from more or less white to more or less black. The result agrees with Mendel's doctrine, according to which every individual possesses a mosaic of genes, all of which appear in pairs containing one gene from the father and one from the mother. In passing on, these genes are reshuffled. Half is discarded, and when the sperm cell fuses with the egg, a new mosaic is set up, which may have varying

characters. There is no call for me to go deeper into Mendelism here. I will only say that Mendel's discovery implies an advance in thought as significant as that which the Atomic Theory had for chemistry. In questions of materia, there are two possibilities open. We can imagine substances which can be split up *ad infinitum*. This was the older view, on which alchemy was based, and as long as this view was applied, it was difficult to get anywhere. When the idea came into force of materia being built up of small particles, atoms, which could not be split without changing character, possibilities of advancement were at once opened up. The case was the same in heredity investigations. Where ideas of inheritable substances were involved, the theories never agreed with the experiments. Auxiliary hypotheses as to atavisms, etc., were set up. The problems appeared extremely knotty, since one substance ought to differ in so infinitely many respects from another. It was impossible to concentrate on separate qualities and thereby obtain a survey of the layout of the problem. Mendel's strength lay not only in the theoretical advance in thought he was able to achieve but also in his effort to verify his hypotheses by simple experiments. Oddly enough, Mendel obtained an inexplicably good agreement in his experiments. His material has been statistically treated, and it has been possible to ascertain that he obtained throughout fewer divergences than one would expect. It is possible that the reason for this was that Mendel was a teacher in a monastery school and not a professional scholar. For a teacher, the important thing is not to show scientifically that he is right, but to be able to demonstrate for his thick-headed pupils in such a way that they understand how right he is.

When speaking of races, one connects up not with Mendel's mosaic doctrine but with the older, substance one. In anthropology it is impossible to separate off an older phase, when erroneous conceptions of heredity were used, and a later one when more correct views came into their own. In anthropology, Mendelism is not the milestone it is for botany and zoology.

The phrase "pure races" is still used, calling up an image of earlier, never observed, uniform races. Behind this line of reasoning lies the conception of substances such as copper, tin and the like. Different individuals can have varying characters, just as objects of copper can be cooking utensils or ornaments. The private individual can have varying qualities, but his inheritable substance and his soul have something in common with the race. We speak of the quintessence of a

race, and affirm that two races are essentially different in the same way as two metals display inner differences, i. e. when it is a question of the construction of the actual molecules. The result of this sort of race differentiation is that if one difference can be shown between two groups we consider ourselves justified in stating that there is an endless number of differences, in the same way as a demonstration of one difference between two elements gives us the right to assume a large number of other differences. It is further possible to speak of mixed races and say that an individual is of preponderantly Nordic or preponderantly Alpine race, in the same way as it is possible to speak of alloys such as bronze, which has a larger or smaller percentage of copper. In other words, it is clear that the analogies and ideas of a more general kind, on which the modern racial doctrines build, are erroneous. It is equally clear that it is only a question of time as to when Mendelism and its consequences will come to permeate anthropology also.

Characterization of races according to Mendelism

The question which then arises is how, according to the Mendelian conception, races ought to be characterized. According to Mendelism, one should attach most weight to the characters of the individuals, and as well, try to determine whether an individual is homozygous or heterozygous as regards special characteristics. If two individuals belonging to different racial groups have the same genotype in respect of the qualities considered fundamental, then they ought to be regarded as more similar than two individuals belonging to the same racial group who exhibit divergent characters as regards fundamental qualities. If it is a question of employing a person for a certain piece of work, one surely, under normal circumstances, prefers an intelligent and capable man, even if he belongs to an alien race, to an imbecile and perhaps vicious individual, belonging to one's own.

Now, we have not sufficient knowledge of the human beings' genotype to be able to characterize them as homozygotes or heterozygotes. It will be very long before such a characterization is possible. It is furthermore clear that there are differences of more or less pronounced kind between populations in different regions. We must have a name for these differences. We must, consequently, still resort to the conception of race. It should, however, be borne in mind that this conception is a last resort to characterize groups on

which our knowledge is deficient. For this very reason, special care should be taken in race research not to state more than has been observed and can be proved, and to be especially chary of speculation.

Quantitative and qualitative group differences

We have already said that not every difference between individuals can be called a racial difference. The differences must be referred to groups. A quality is missing in the one group, but is found in the other, or has a different frequency, or is on an average developed to differing degrees. We can speak of quantitative and qualitative differences, etc. First and foremost, our task now is to say what is meant by a group. It must be a question of an isolate or a number of isolates. By isolates is implied a collection of individuals between whom crossing occurs more or less at random. An isolate can be geographically demarcated, for example a remote village or something of the kind. There may also be social isolates, i. e. groups of persons who seldom marry outside a certain circle.

We do not say that tall persons in a people constitute a special race, which in respect of height differ from the short ones. This is because the tall persons cross freely with the short. To be able to speak of a race difference, it is not enough to say that the difference between the long and the short individuals is conditioned by heredity and that both can be said to constitute each their own group.

The question then arises: Which is the smallest difference required to make it possible to speak of two different races? We do not think that a slight difference in height—for example, that between the upper and lower classes in certain countries—is a racial difference, although the difference is hereditary and though both classes constitute separate groups of isolates. We demand differences of greater magnitude before speaking of different races. There is, however, no possibility of giving a lower limit as to when we are justified in claiming the presence of a racial difference. The conception of race is, as has been said before, vague. And it is impossible to reach an altogether clear definition because the conception is based on inadequate knowledge.

Another question, also impossible to answer, is: When is one justified in speaking of a pure race? Usually, as has been said, one has an idea of the existence, earlier, of purer races than the present ones. When, for example, Retzius and Fürst carried out, in the years 1897-98, their anthropological investigation of Swedish conscripts,

they came to the conclusion that only 10.07 percent were of pure Nordic race ("der reine ungemischte germanische Typus in Schweden"). They delimited this pure race in such a way that the height should be over 170 cm., cephalic index under 75, eyes light and hair blond. These delimitations were drawn absolutely arbitrarily. A pure Nordic race not varying outside these limits has never been observed. Nevertheless, they imagined that earlier, fundamental parts of the population had been purer, from a racial viewpoint, than now, and that if one went back far enough, it would be found that the population of Sweden had varied just within these same limits, before it became mixed as a result of immigration. This supposition can be checked with regard to a single quality, that of the height. Thanks to Hultkrantz (1927), we know the height of Swedish conscripts since 1840. If we go back to this time and assume that the other qualities remain unchanged, we can calculate how great a percentage of the Swedish people it was that, height included, fulfilled the demands set up by Retzius and Fürst. We find that only 3.8 percent did so. The conception of a purer Nordic race in Sweden characterized by a particularly great height, is thus proved to be false. There are, of course, no proofs for the delimitation as regards other qualities which Retzius and Fürst carried out, but considering the results we got with regard to height, there is reason to take a sceptical attitude. Seen in principle, the theory of development surely implies a process of opposite character. Whereas, anthropologically, we think back to older phases with pure races, we assume according to the evolution theory that differences between races and species have become more and more marked. When we go backwards in time, we find fewer differences. As we approach the present, the differences grow more and more pronounced.

It is plain that we ought to abandon the conception of pure races, and confine ourselves to assertions touching what we actually have been able to observe. We should not maintain that there are purer races than the purest ones we have been able to observe. Futhermore, we should not speak of pure races, but instead of racial differences. For a difference to be present, there must be at least two groups. The matter must always revolve around a comparison. We should confine ourselves to stating that there are differences of absolute character between two groups to the extent to which we can differentiate out each individual correctly. If we compare Negroes and whites,

we find an absolute difference in so far as there is no difficulty in the way of a correct diagnosis. If, on the other hand, we compare different groups of whites or of Negroes with one another, we may find at most only relative differences. A number of the individuals can be separated out, but not all.

DEFINITION OF RACE

Proceeding from the criticism of older views of race and the analysis of the conception of race sketched above, I have allowed myself to set up the following definition:

A race is an isolate or a collection of isolates. The hereditary differences between two races can be of an absolute character, so that each individual can be separated out correctly. When this happens we are dealing with races of the first order. The differences can, however, also be of only a relative character, in which case we have to do with races of the second order. One race can, in relation to another, be of the first order, but in relation to a third, of the second order.

Two corollaries belong to this definition:

1. We should not assert that there are more racial differences than those we have actually been able to observe.

2. We have no right to assume the earlier existence of purer races with narrower demarcation than such as it has been possible to investigate.

This definition involves certain practical consequences. In anthropology observations have been widely accepted which have not been accounted for numerically. The systems in species investigations in zoology and botany have been imitated, and it has often been enough to state that the one race has been found, when observed direct, to possess certain qualities missing in the other. Concerning races of the first order, it is of course permissible to make such observations. No figures are needed to show that there is a difference in the color of the skin of Negroes and whites. When dealing with races of the second order, however, it is necessary to set to work in a more exact fashion. This has been felt, and statistical methods have to a certain extent begun to be applied in anthropology. Hitherto, however, those concerned have contented themselves with investigating whether, in two groups, differences have been present between means which, with

regard to the standard errors, were statistically significant. But no consideration has been given to the size of the differences and to the variability around the standard errors, which to a greater or less extent could be common. When a difference in height between Lapps and Swedes could be ascertained, it was contended that these two had different race types. When differences between other groups in Sweden were established, the presence of a race difference was also asserted, without giving in any more detail what these differences consisted in. Naturally, the different magnitude in the differences in question was not altogether disregarded, but there is no satisfactory method for a more complete elucidation of the situation.

In carrying out an anthropological investigation of Lapps, I had occasion to take up an attitude to problems of this kind, and worked out a method for race analysis which seems to me to be generally usable. The line of thought here followed was this: Assume that we mix Lapps and Swedes in a market-place. Our next job is then to sort out the two groups correctly, using our knowledge of racial qualities, so that we can first sort out according to simple qualities. If we know the medium height and the range of variation as regards height which characterizes Lapps and Swedes, we can sort out a number of individuals correctly. Certain persons are so short that they must be Lapps; others are so tall that they must be Swedes. After this, we proceed to the next quality. When we have worked through the separate qualities in this way, we can turn to combinations of qualities. A Lapp may, for example, have a certain cranial index and a certain height. Individuals with the same height and the same cranial index are found among the Swedes. But the same combination of the two qualities is found so seldom that we can be sure that anyone displaying it is a Lapp. Two qualities are first combined, then three, etc. In this way a percentage figure can be reached showing the extent to which individuals belonging to the two races can be distinguished in a material consisting of Lapps and Swedes. I shall not give the statistical formulae used in this connection; they are published elsewhere. As regards their nearer significance, I will only point out that if qualities are correlated with one another, less is obtained in a sorting of this kind than when they are not correlated. It is, after all, self evident that if the correlation is pronounced, little is gained by going from the one quality to the other. If the correlation is slight, a great deal will at first be gained, but after a moderate number

of qualities, the gain becomes negligible. After 7 to 8 qualities at low correlation, possibilities of a correct diagnosis will not increase noticeably.

In the treatment of the material, however, it is possible to go one step further: that sorting can be made which gives the best result. Here the boundary is drawn at the point where the two distributions intersect one another.

The result obtained in a treatment of a material comprising 269 Lapps and 1000 Swedish conscripts selected at random is as follows. Figure 1

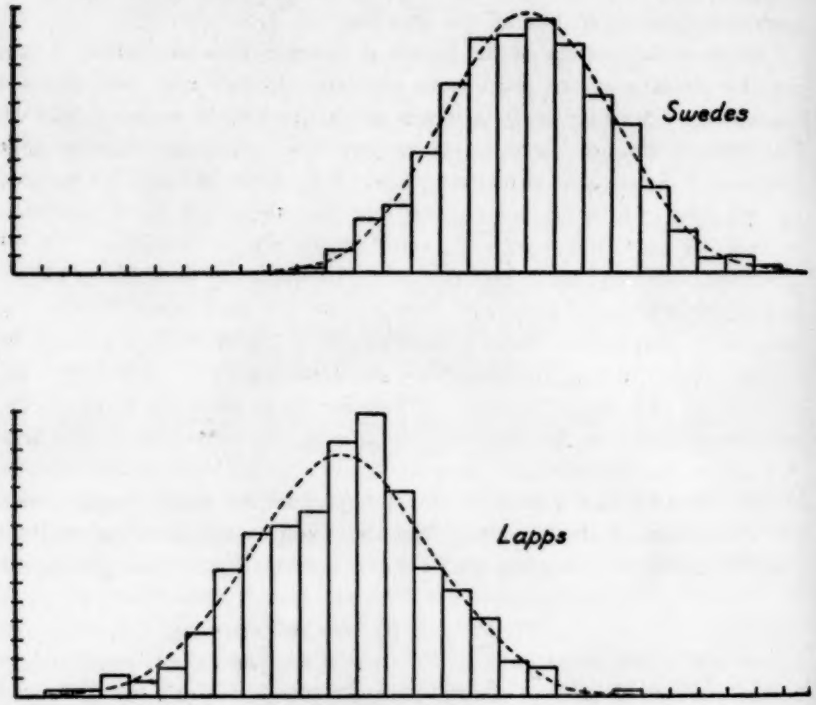

FIG. 1. DISTRIBUTION IN REGARD TO STATURE OF 1,000 SWEDES AND 269 LAPPS (MEN)
The fit of the curve is less good for the Lapps because of the smallness of the number.

shows the distribution of the height in Lapps and Swedes. In the diagram is given the calculated distribution curve for both groups. That the divergency for the Lapps is greater than it is for the Swedes

is due to the fact that the material is smaller, so that greater irregularities arise at random. Figure 2 gives the result from a sorting

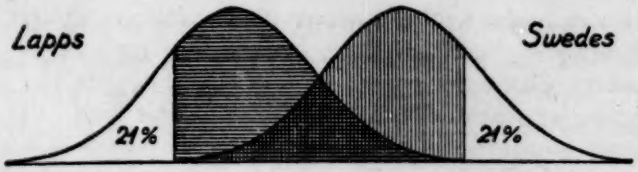

FIG. 2. DISTRIBUTION OF LAPPS AND SWEDES ACCORDING TO STATURE

solely according to height. It can be seen from the figure that it is possible with the help of the height theoretically to sort out 21 percent of the total material as Lapps and an equally large percentage as Swedes. The empirical figures were 21 percent for the Lapps and 22 percent for the Swedes. If we combine height and cranial index, we can theoretically sort out 37 percent of the Lapps (Figure 3).

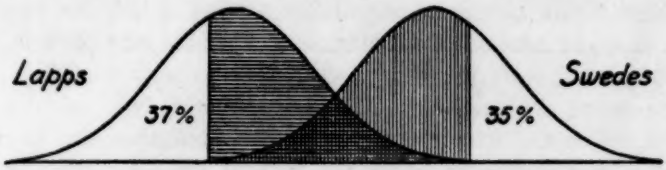

FIG. 3. DISTRIBUTION OF LAPPS AND SWEDES ACCORDING TO STATURE AND HEAD INDEX COMBINED

The observed figure was 37 percent. If we combine height, cranial index and facial index, 50 percent of the Lapps can theoretically be sorted correctly (Figure 4). The observed figure was 52 percent.

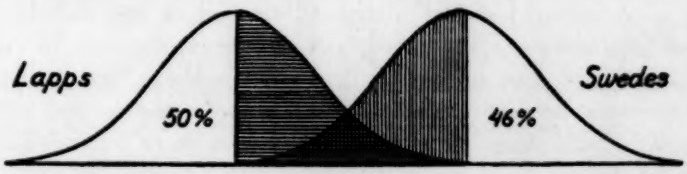

FIG. 4. DISTRIBUTION OF LAPPS AND SWEDES ACCORDING TO STATURE, HEAD INDEX AND MORPHOLOGICAL FACE INDEX COMBINED

If we now also use the separate qualities of cranial index and facial index, we arrive at the result that 57.6 percent of the material can

with certainty be proved to be Lapps and 51 percent of it Swedes. Roughly speaking, then, it is possible to give an absolutely correct diagnosis for rather more than half the Lapps and the Swedes.

For a race analysis, it is, however, theoretically of greater interest to reach a figure which gives the best possible sorting. If we use the boundary where the curves for the combined qualities intersect one another, we reach in theory a sorting of this kind: 93 percent of the group sorted out as Lapps will then really consist of Lapps, but 7 percent of Swedes will also be included. It must not be forgotten at this point that if the sorting is done purely at random, no worse result than 50 percent Swedes and 50 percent Lapps can be obtained. The race difference is characterized by how much the figures obtained exceed 50 percent. This difference is 43 percent. Under such circumstances, it is advisable to form an index for the race difference which shows how many "points", of a possible 50, could be reached. The formula for my racial index then becomes $\frac{p - 50}{50}$, where p is the percentage figure obtained. According to this index, the race index of the Lapps in relation to the Swedes is 0.86. It may perhaps appear astonishing that it is possible to carry out to such a wide extent a correct sorting of Lapps and Swedes with the help of only three qualities. Readers may therefore be reminded that the Lapps are entered in the church books as far back as the year 1750, and that the nomadic Lapps we are dealing with here have to a certain extent settled down, with time, and mixed with Swedes. A certain breaking of an isolate has taken place. This, however, has been all on one side. The Swedes have not mixed with the nomadic Lapps, nor adopted their method of living. We do not know the extent to which admixture took place in earlier times.

It is of course possible to proceed further on the path we have started and complete the analysis with the application of further qualities. I have seen no motive for this, however, since the problem of differences between nomadic Lapps and Swedes is not, as such, particularly interesting. Further, it is not possible to determine beyond all doubt the extent to which the difference between the two groups is due to environment. The Lapps have a wholly different mode of living from that of the Swedes. It is, for example, possible that the scanty food affects their height and that the difference between Lapps and Swedes in this connection is one of nutrition. If we compare

groups living in similar environmental conditions, it is not necessary to think of such sources of error. As concerns the Lapps, however, the differences are so striking that it is not possible to draw definite conclusions at once.

Finally, I should like to say that, for me, the question was not so much to investigate the difference between Lapps and Swedes: the main thing was to attain a more satisfactory method for the analysis of race differences. Even if the mathematical discussions and the formulae used in the treatment are a little complicated, the numerical results obtained are concrete and easily grasped. A figure is reached which expresses the size of the average difference between the groups, consideration being given to the extent to which the variation ranges of the two groups cover one another. The calculation furthermore takes into consideration the extent to which a correlation between qualities exists, and the result satisfies the claims for exactitude which are usually imposed by the discipline of the Natural Sciences. It gives no scope to imaginative ideas and subjective impressions.

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NOTES

NOTE ON THE DEATH RATE AMONG PERSONS RECEIVING OLD-AGE ASSISTANCE IN RHODE ISLAND

THE quotients obtained by dividing the number of Old-Age Assistance recipients dying in a year period by the monthly average number of recipients during the same period are as follows for four recent periods (two of which overlap):

Fiscal year 1938-39	.0835
Fiscal year 1939-40	.0727
Calendar year 1940	.0755
Calendar year 1941	.0708

It is therefore evidently justifiable to take the total OAA death rate as between 7 and 8 percent, and it may be decreasing.

The age-sex structure of the receiving load was examined in June 1941. If we apply the percentages then secured to the average caseloads and divide the figures so arrived at into the deaths by sex, we obtain the following quotients:

	Males	*Females*
Fiscal year 1938-39	.0954	.0739
Fiscal year 1939-40	.0792	.0676
Calendar year 1940	.0781	.0735
Calendar year 1941	.0807	.0629

We may therefore estimate the male rate at about 8 percent and the female rate at about 7 percent.

It remains to derive parallel rates for the age groups. The base population for this may be obtained from the distribution above mentioned for the receiving load as of June 1941; the deaths are directly tabulated. The rates are:

	Ages 65-69	70-74	75-79	80-84	85-
Males					
Fiscal year 1938-39	.0804	.0718	.1018	.1531	.2417
Fiscal year 1939-40	.0545	.0659	.0858	.1258	.2188
Calendar year 1940	.0457	.0577	.0816	.1295	.3673
Calendar year 1941	.0516	.0598	.1084	.1192	.2178
Females					
Fiscal year 1938-39	.0478	.0559	.0889	.0960	.2096
Fiscal year 1939-40	.0385	.0527	.0745	.1242	.1412
Calendar year 1940	.0346	.0525	.0891	.1284	.2056
Calendar year 1941	.0333	.0535	.0595	.1016	.1979

Since the bases of these rates do not differ greatly, they may be summarized in averages, viz.:

	65-69	70-74	75-79	80-84	85-	Last three groups (i.e. over 75)
Males	.0581	.0638	.0944	.1319	.2614	.1197
Females	.0386	.0536	.0780	.1126	.1886	.1018

The comparison of these with the corresponding rates for the general population is a matter of some interest. The Sixteenth Census shows 24,265 males and 30,019 females over 65 in Rhode Island April 1, 1940. 1785 males and 1848 females died at ages over 65 during the calendar year 1939, so we have as an estimated total death rate for the aged population in general:

.0669

as compared with the OAA average of .0756.

The sex-specific rates for the general population, computed by the same method, are:

Males	Females
.0736	.0616

as compared with the OAA averages of .0834 and .0695.

The age-specific rates for the general population, for the age groups used by the Census (which may be compared with the OAA averages above), are:

	65-69	70-74	75-
Males	.0443	.0666	.1301
Females	.0325	.0549	.1095

It thus appears that the disadvantage of the OAA recipient in the matter of death rates is concentrated in the 65-69 age group, since the difference is slightly in the reverse direction in the older groups. However, the rather small populations and the approximations necessarily involved in this determination require caution in the use of this result. The study must be regarded as exploratory, and further investigation under more favorable conditions is necessary to establish the conclusions more firmly.

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RECENT LITERATURE

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